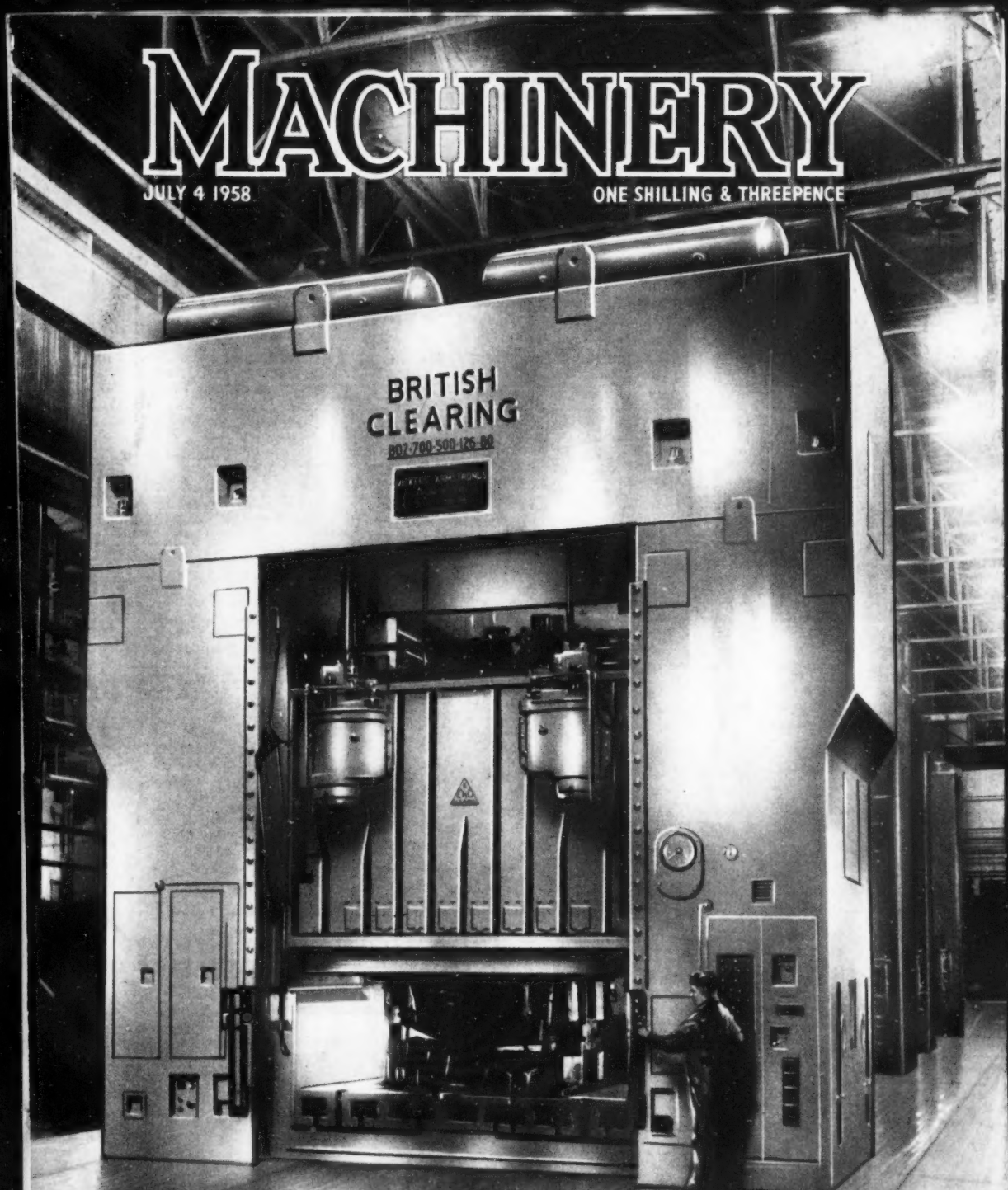
MACHINERY

JULY 4 1958

ONE SHILLING & THREEPENCE



BRITISH CLEARING Presses used by
Ford Motor Company Ltd., Briggs Body Division

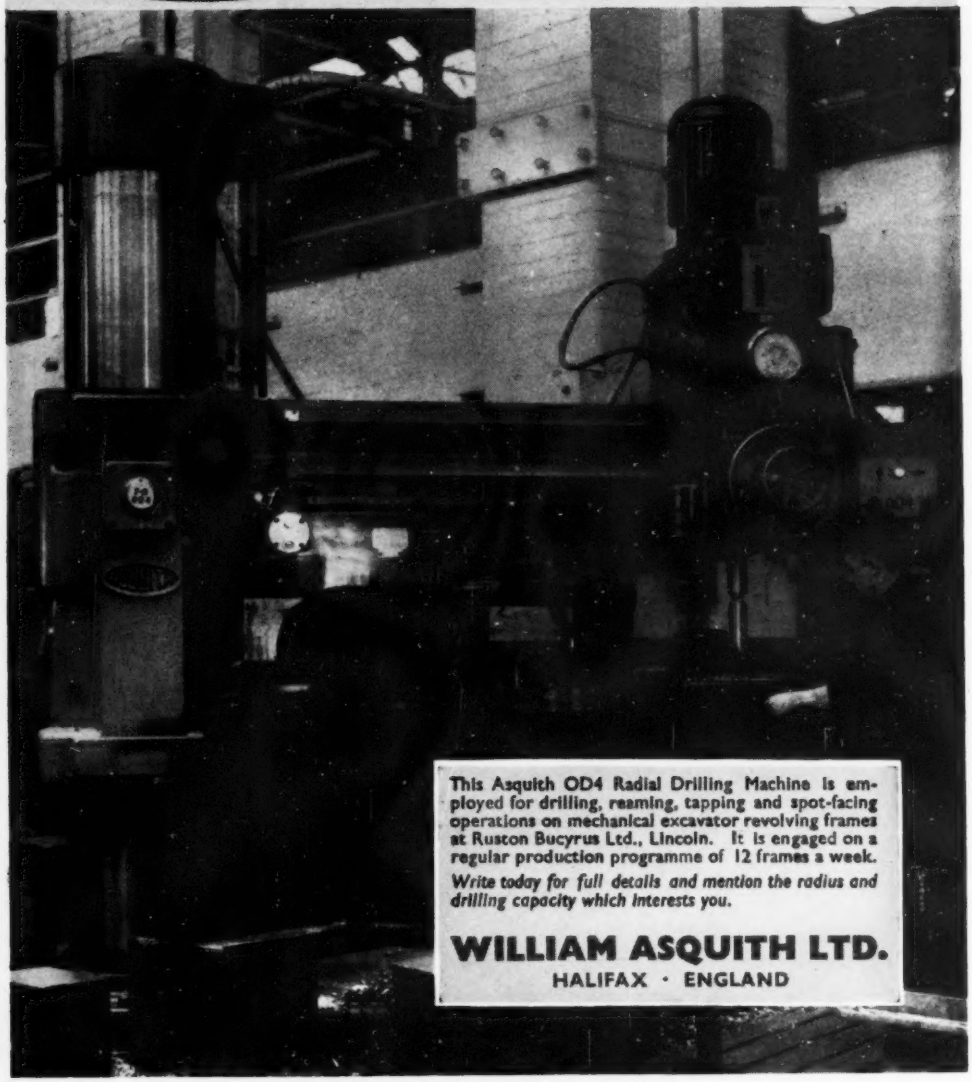
BUILT BY VICKERS

ROCKWELL
MACHINE TOOL CO. LTD.

ASQUITH

OD4 The BIG RADIAL

for the up-to-date Heavy Shop



This Asquith OD4 Radial Drilling Machine is employed for drilling, reaming, tapping and spot-facing operations on mechanical excavator revolving frames at Ruston Bucyrus Ltd., Lincoln. It is engaged on a regular production programme of 12 frames a week.

Write today for full details and mention the radius and drilling capacity which interests you.

WILLIAM ASQUITH LTD.
HALIFAX · ENGLAND

Sales & Service for . . . **DRUMMOND-ASQUITH** *. . . the British Isles*

DRUMMOND-ASQUITH (SALES) LTD., KING EDWARD HOUSE, NEW ST., BIRMINGHAM

'Phone: Midland 3431 (7 lines) 'Grams: Maxishape, B'ham. Also at LONDON: Phone: Trafalgar 7224 (5 lines) and GLASGOW: 'Phone: Central 0922

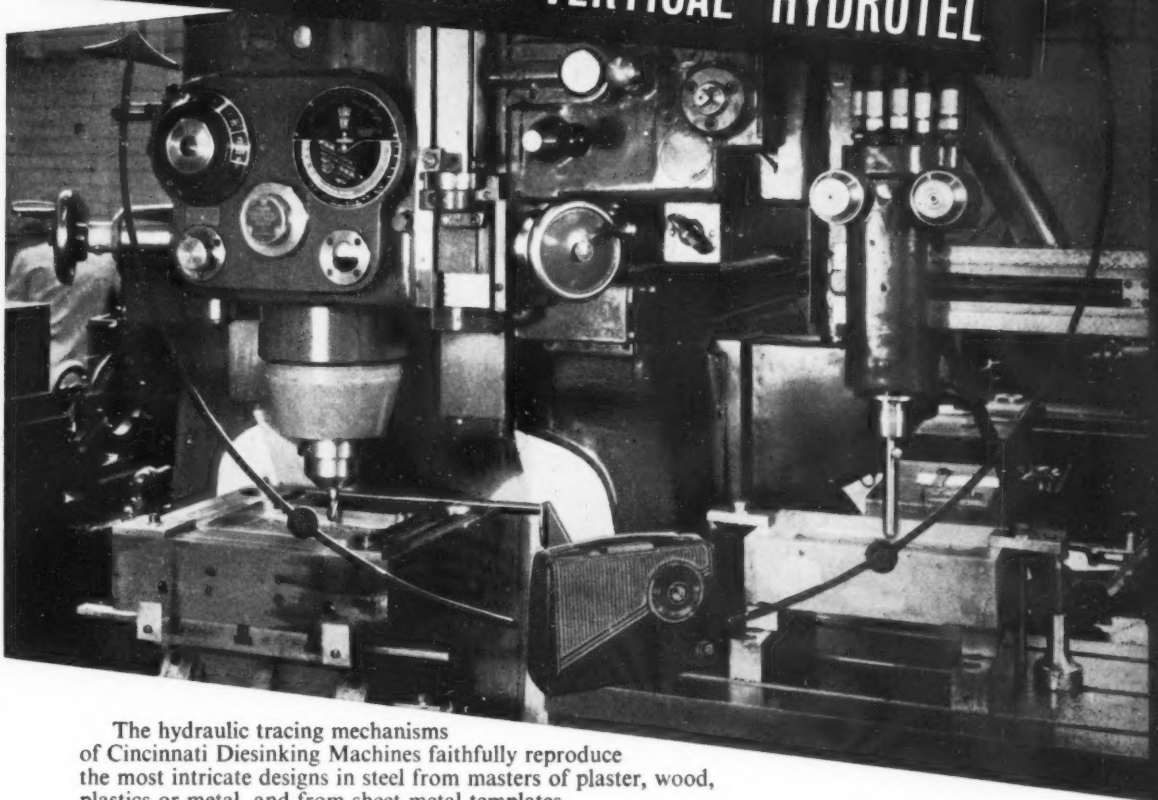
A 173

The DIES for this Rhapsody in Blue

(OR ANY OTHER COLOUR THAT MAY TAKE YOUR FANCY)

are produced automatically on a

16" x 30" Cincinnati VERTICAL HYDROTEL



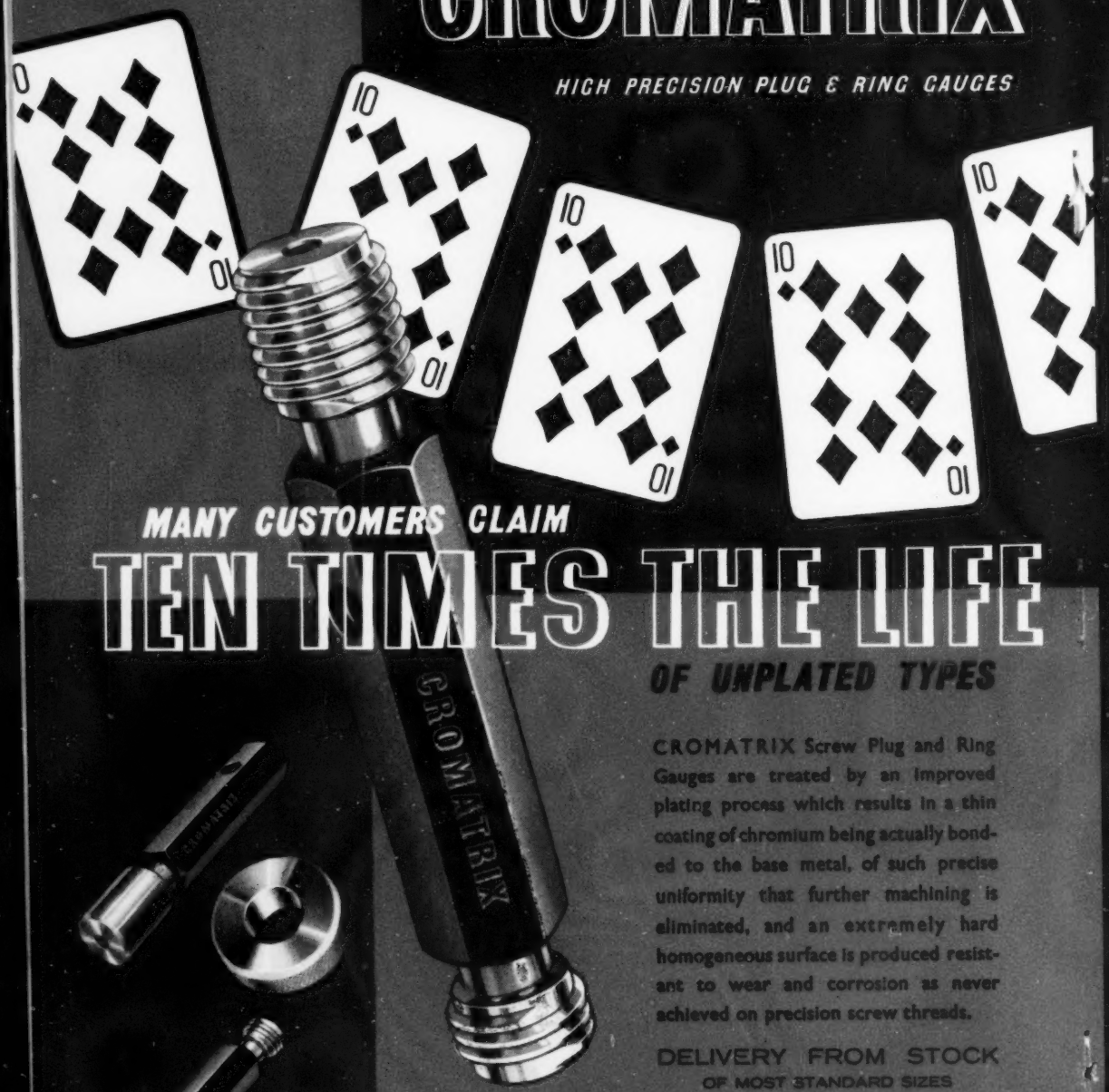
The hydraulic tracing mechanisms of Cincinnati Diesinking Machines faithfully reproduce the most intricate designs in steel from masters of plaster, wood, plastics or metal, and from sheet metal templates.
In the illustration, a die is being cut for Kolster Brandes "Rhapsody" portable radios.
The skill of the professional diesinker is built into the machine; dies are cut accurately, quickly and completely automatically.

Send NOW for catalogues:

M.1731-E. Tool and Die Miller, for die blocks up to 8" x 18".
M.1497-E. 16" Vertical Hydrotel, for dies up to 16" x 30".
M.1773-E. 28" Vertical Hydrotel, for dies up to 30" x 60".

CROMATRIX

HIGH PRECISION PLUG & RING GAUGES



MANY CUSTOMERS CLAIM

TEN TIMES THE LIFE

OF UNPLATED TYPES

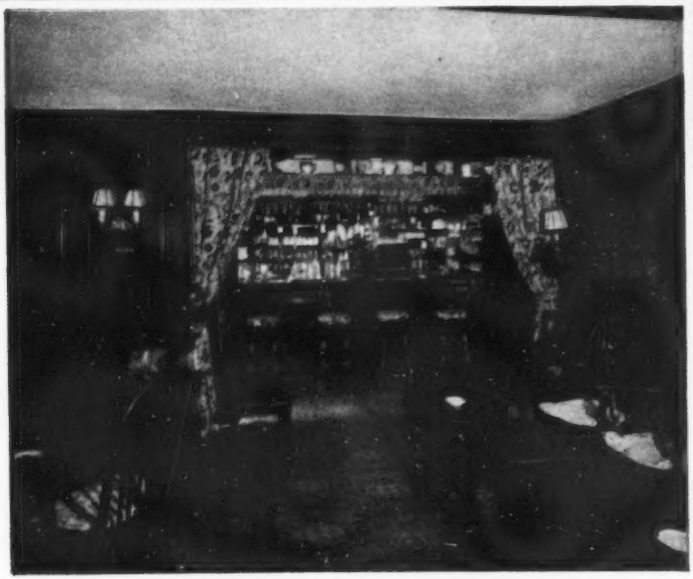
CROMATRIX Screw Plug and Ring Gauges are treated by an improved plating process which results in a thin coating of chromium being actually bonded to the base metal, of such precise uniformity that further machining is eliminated, and an extremely hard homogeneous surface is produced resistant to wear and corrosion as never achieved on precision screw threads.

DELIVERY FROM STOCK
OF MOST STANDARD SIZES

Coventry Gauge

& TOOL COMPANY LTD

P.O. BOX 31, COVENTRY, ENGLAND



Cocktail Bar at the Whittington Inn, near Stourbridge (main Kidderminster-Wolverhampton road). Built in 1310, this former Manor House of the De Whittingtons became an inn about 1783 and is as well known to-day as ever it was in the heyday of the Coaching Era. *Illustrations by courtesy of A. J. Hogg, Esq.*

Bright Bars!

The Vogue in Cocktail Bars may change from time to time, but there is no passing vogue in Coghlan Precision Bright Bars. For fifty years they have maintained a consistently high quality which has never failed to meet the most exacting demands of ever improving techniques in every sphere of engineering production.

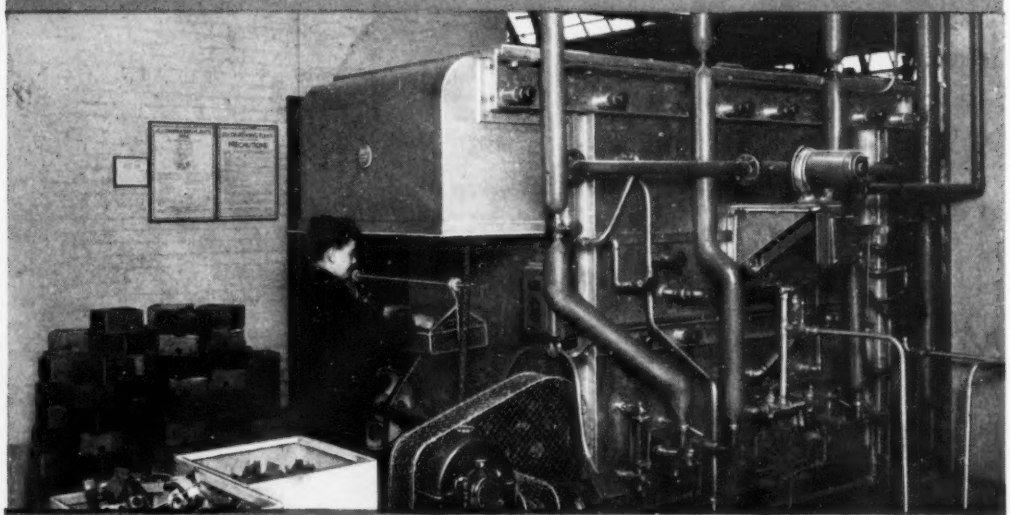
Please ask for a copy of new edition of our Products and Useful Data Booklet.

COGHLAN Bright Steel Ltd.

Hunslet Forge, Leeds, 10. Telephone : 75477 (5 lines) Grams : Coghlan, Leeds.

One good plant sells another

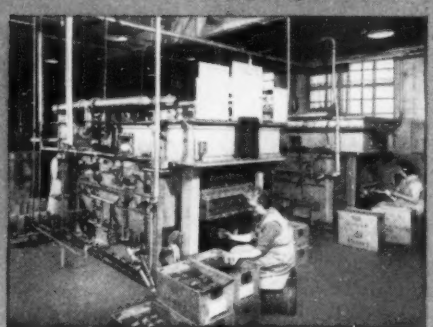
1935 I.C.I. supplied a mechanised trichloroethylene degreasing plant to M. K. Electric Ltd. to provide boiling liquor and vapour treatment for cleaning switch boxes, conduit boxes and covers before phosphating and painting. Basket loads of work were carried through the plant suspended from spacer bars fitted to the plant conveyor system—a pair of endless chains running at a speed of 4 ft/minute. A throughput of sixty baskets of work an hour was achieved using only one gallon of solvent for each ton of parts cleaned.



The original plant in service

1952 A second plant was installed. Apart from a few minor modifications, this plant was similar to the earlier one.

1955 After 20 years' continuous service, the first plant was replaced by another plant, identical to that supplied in 1952.



The two later plants in service

ICI **Imperial Chemical Industries Ltd., London, S.W.1**

BP251

CENTRELESS HIGH PRODUCTION
BAR PEELING AND TURNING MACHINES
TYPE WDSN

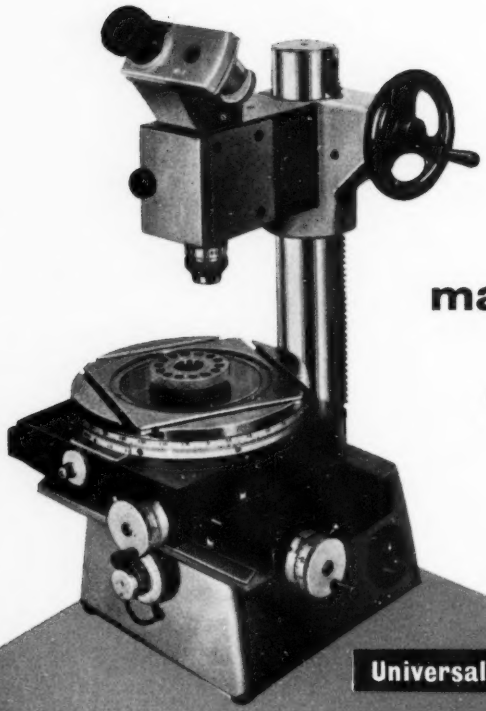
Lower Wages and more production

THROUGH A COMBINED
BAR PEELING AND STRAIGHTENING PLANT
OPERATED BY ONE MAN

TH. KIESERLING & ALBRECHT SOLINGEN GERMANY

Branch Agent:
F.W. Kuboot Ltd., 12 Sylvan Road, London S.E. 19

HIGH PRODUCTION
BAR STRAIGHTENING AND POLISHING MACHINES
TYPE WRPT



made to measure

. . . in all workshops

Universal Measuring Support Type U-10

Precision-built, versatile and mobile, the U-10 Measuring Support with its wide range of accessories brings to even the smallest workshop the assurance of speedier, more accurate inspection of machined parts.

Universal scope The U-10 Support is used for measuring flat and cylindrical parts, balls and diameters of threads by comparison with a standard or reference gauge. Accessories permit inspection of angles and thread profiles, vertical measurement in absolute value and measurement in rectangular and polar co-ordinates in a horizontal plane.

Portable Lightweight and of compact design, the U-10 Support presents no transport problems. It sits easily on the inspection bench and can be quickly moved from workshop to workshop.

The U-10 Measuring Support is one of several measuring instruments in the manufacturing programme of Société Genevoise d'Instruments de Physique.

Others are:

MUL-1000, MUL-3000 and MUL-4000 Universal Measuring. Machines of 1, 3 and 4 metre linear capacity.

MUL-250 Shop Gauge Measuring Machine.

MU-214B Three Co-ordinate Universal Measuring Machines.

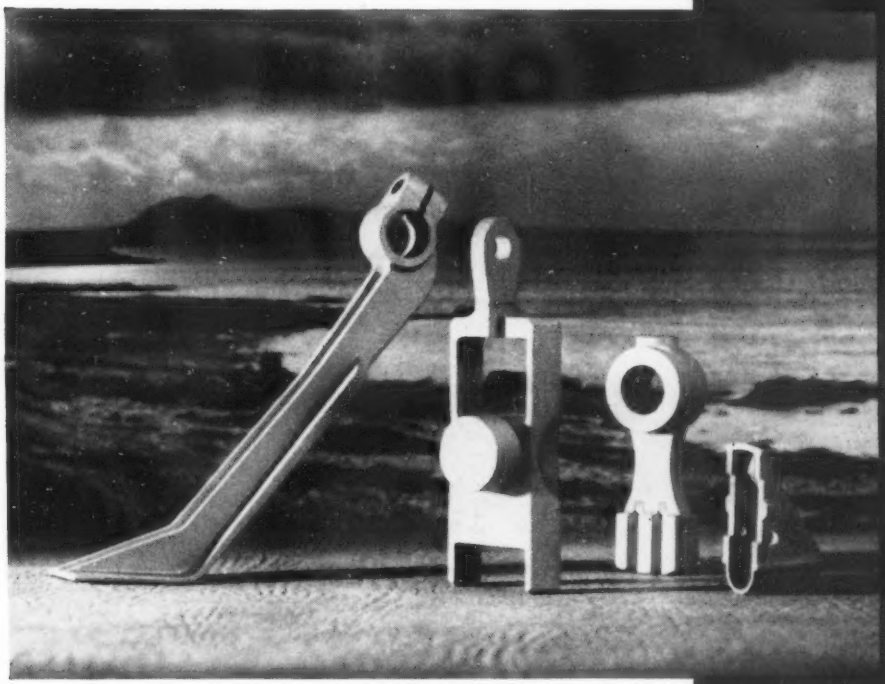
Detailed information about SIP Measuring Machines is available from Société Genevoise Ltd., Newport Pagnell, Bucks. Telephone: 460.1.2

Measuring Machines by SIP

the Measure of Measures

PRECISION CASTING

SILESTER O
CUTS MACHINING AND COSTS



"Examples of investment castings for the engineering industry manufactured by the Picast process by P. I. Castings (Altrincham) Ltd. These may vary in weight from .75 gm to 1,600 gm."

Used as an investment bonding agent, Monsanto's ethyl silicate Silester O facilitates the production of intricate castings of high dimensional accuracy, requiring no machining except in the case of "machine fit" tolerances.

The casting of parts with large unsupported cores presents no problem with Silester O. The danger of sagged moulds or interior cores is reduced. Close control is effected and overheads are lowered.

Write for more information. *Silester is a Registered Trade Mark.*

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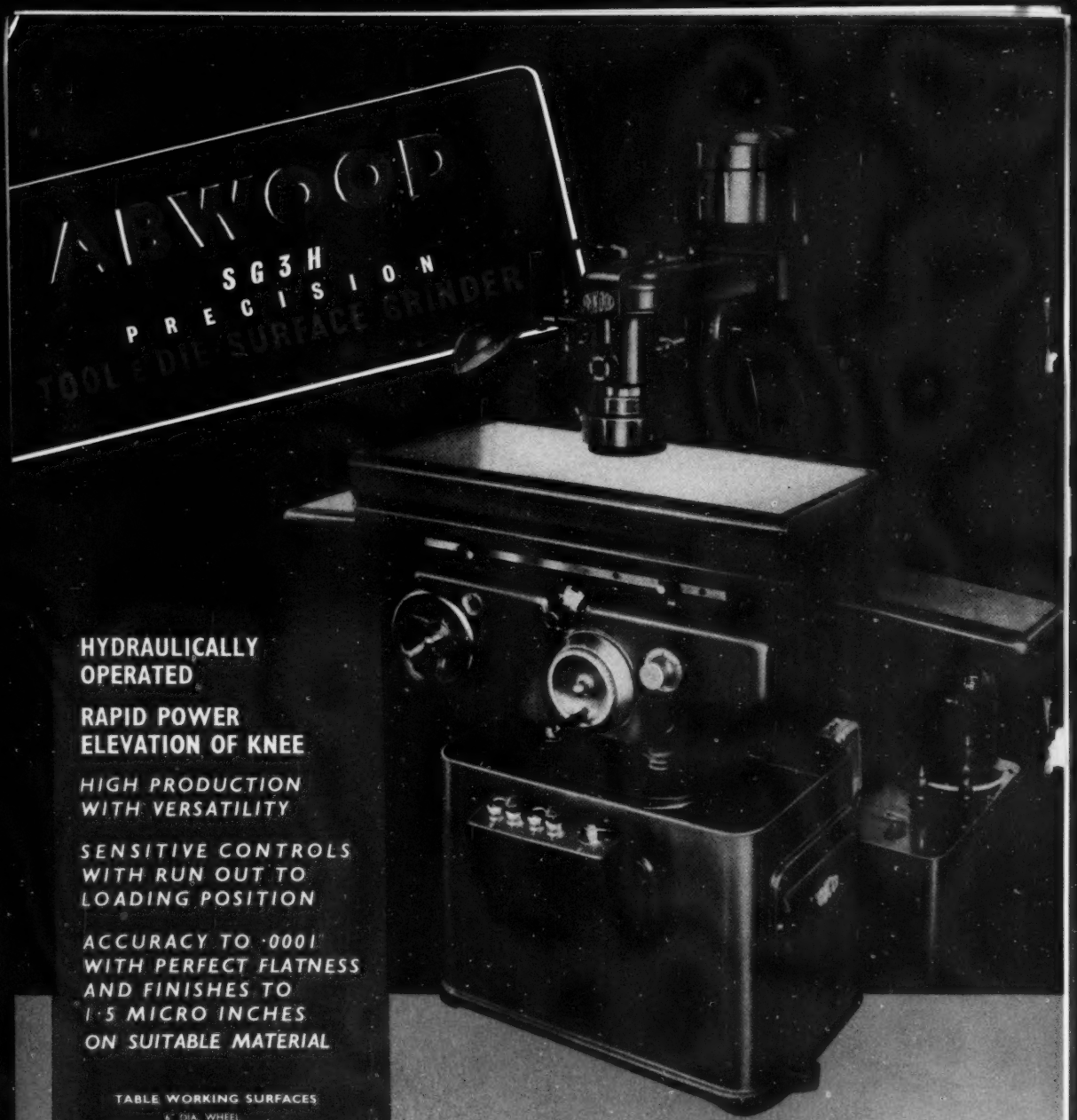
In association with: Monsanto Chemical Company, St. Louis, U.S.A. Monsanto Canada Limited, Montreal. Monsanto Chemicals (Australia) Ltd., Melbourne. Monsanto Chemicals of India Private Ltd., Bombay. Representatives in the world's principal cities.

Monsanto

Monsanto chemicals help industry – to bring a better future closer



HYDRAULICALLY OPERATED

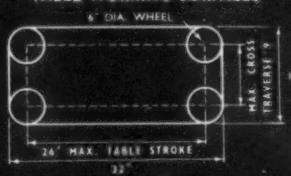
RAPID POWER ELEVATION OF KNEE

HIGH PRODUCTION WITH VERSATILITY

SENSITIVE CONTROLS WITH RUN OUT TO LOADING POSITION

ACCURACY TO ·0001 WITH PERFECT FLATNESS AND FINISHES TO 1·5 MICRO INCHES ON SUITABLE MATERIAL

TABLE WORKING SURFACES



10½" UNDER WHEEL

This latest development model SG3H is "the" Machine for rapid Surfacing in the Toolroom or Production Shop.
Detachable Spindles are available for deep and intricate work.

Hydraulic Control allows the operator to "inch" the Table along or stop instantaneously in any position at will.

Auto Run-out of Table to loading position.

Built in Coolant system with separation unit in Base.

Uses 6" Diameter Cylinder Wheels for faster Surfacing and Maximum wheel economy.

Machinery 8
July 2, 1958

ABWOOD MACHINE TOOLS LTD., PRINCES ROAD, DARTFORD, KENT

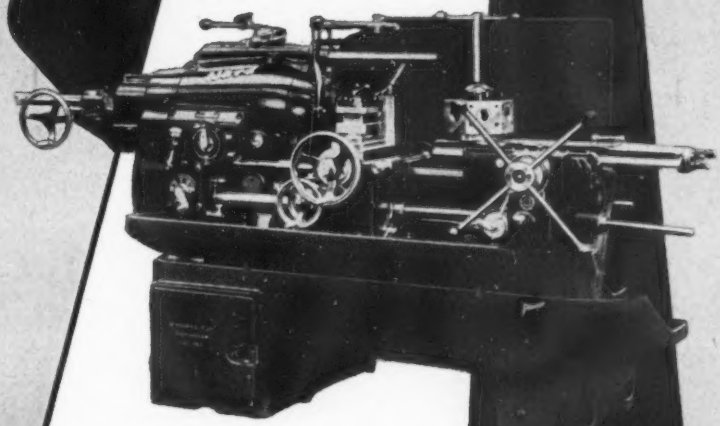
Telegrams : ABWOOD DARTFORD

SG-1

For Maximum Production

THE NEW
3C
CAPSTAN LATHE

Ward



- INBUILT ELECTRICAL EQUIPMENT
- 12 SPINDLE SPEEDS. BOTH FORWARD & REVERSE
- HIGHER CENTRES GIVING INCREASED SWING
- LARGE CAPACITY SWARF PAN
- BED PROTECTED BY STAINLESS STEEL COVERS

Many new features include:

1¼ IN. BAR CAPACITY.

Full details of our complete range of Capstan and Turret Lathes on request.

H·W·WARD & CO LTD

SELLY OAK
BIRMINGHAM 29
TELEPHONE SELLY OAK 1131

BRITISH MACHINE TOOL MAKERS ASSOC. LTD

W663

B

6 × 4 = 24

TYPES OF FEED | SPEED RANGES | POSSIBLE COMBINATIONS

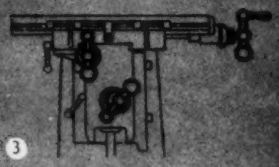
that's the beauty of the

A&S

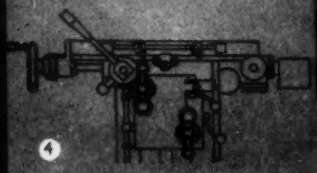
MODEL '1' HORIZONTAL MILLER

1 Hand Feed—lever, screw, lever.

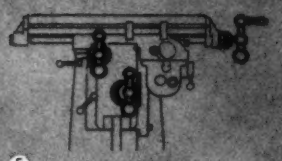
2 Hand Feed—lever, lever, lever.



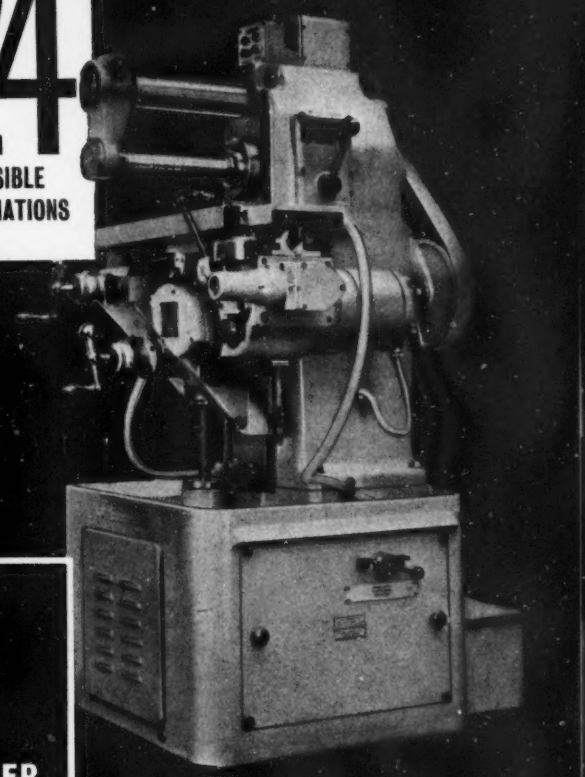
3 Hand Feed—Screw, screw, screw.



4 Multiform—semi-automatic cycle.



5 Normal automatic feed.



6 With automatic cycle.

WHY PAY FOR 'SPECIAL' FEATURES YOU MAY NEVER USE?

When you equip with A. & S. Model '1' Millers you choose from 4 ranges of speeds and 6 different feed arrangements the best combination* for a particular job. Both hand-feed and automatic types can, however, be supplied with special attachments for special operations. No other small milling machine offers similar versatility or higher production capacity for so wide a range of work.

TABLE 26" x 7"
LONGITUDINAL TRAVERSE = 10"
VERTICAL TRAVERSE = 10"
TRANSVERSE TRAVERSE = 5½"-6"

**With the A. & S. Model '1' brochure in front of you, you would know exactly what we mean.*

Built up to a standard-not down to a price

Write for illustrated leaflet.

ADCOCK & SHIPLEY LTD.

P.O. Box 22, Ash Street, Leicester. Telephone: Leicester 24154-6
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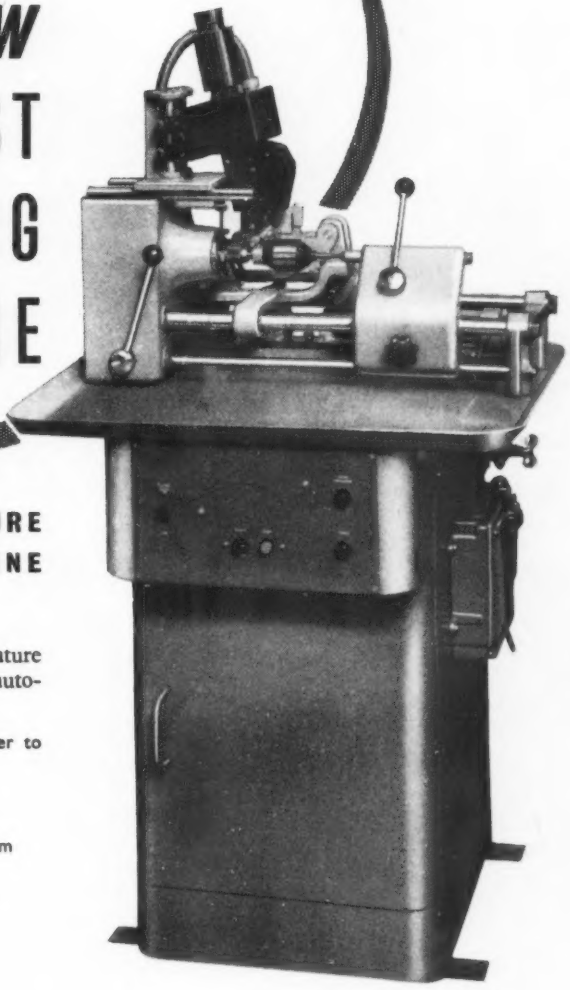
Announcing-

NEW COST CUTTING MACHINE



AN ELECTRONIC ARMATURE UNDERCUTTING MACHINE

by E.M.I.

This electronically controlled armature undercutting machine is completely automatic and simple to operate.

- ✳ Automatic alignment of slot with cutter to within 0.002 in.
- ✳ Operating time cycle 1 second per slot
- ✳ Automatic counting
- ✳ Quick release loading and unloading system

For armatures of the following sizes:

COMMUTATOR	Diameter 0.5 - 2 in.
	Length 0.25 - 2.25 in.
ROTOR	Maximum diameter 4 in.
	Maximum length 9 in.
	Maximum weight 25 lb.
	Number of slots 9 - 125

Other E.M.I. equipment designed for the needs of the Electric Motor manufacturer, include:

Automatic Armature Tester • Dynamic Balancing Machine • High Power Stroboscopes

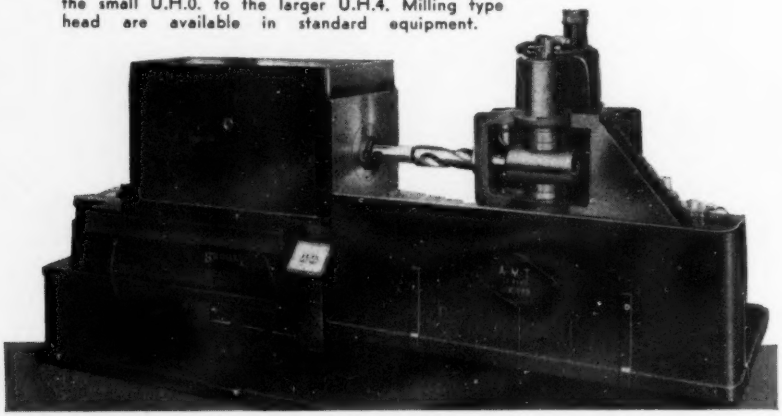
If you would like further information, please telephone or write to:

E.M.I. ELECTRONICS LTD.

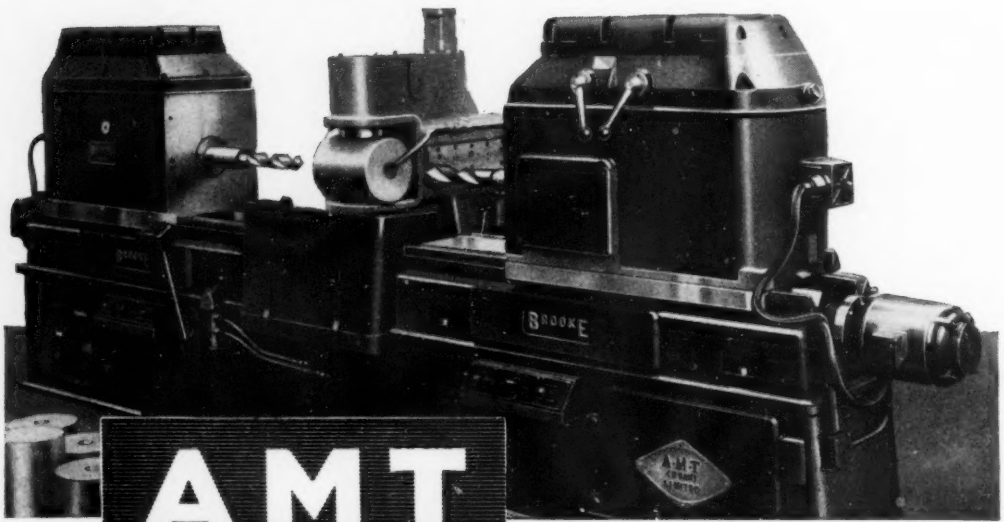
INSTRUMENT DIVISION • HAYES • MIDDLESEX • Telephone: SOUthall 2468 Exts. 1071 & 655

EE103

Set-ups for any number and type of Unit Heads from the small U.H.0. to the larger U.H.4. Milling type head are available in standard equipment.



Single and Double ended
BILLET DRILLING MACHINES



AMT

Enquiries are invited and if you have a production problem our Design Engineers will gladly collaborate with you.

DESIGNED AND BUILT FROM STANDARD UNIT PARTS

A.M.T. (B'HAM) LTD., Bournbrook, Birmingham. Tel.: Selly Oak 1128/9/20. Grams: 'Amtold' B'ham.

Double helical gear for use at the spade and shovel mill of C. T. Skelton & Co. Ltd., 29 in dia. × 11 in face, weight 11 cwt. 2 qr.

Rock for the roll

Two steel castings for bottom bearing boxes for rolling mill at Steel, Peech & Tozer Rotherham; supplied finish machined by Edgar Allen, weight 2 cwt. 2 qr. and 2 cwt. 1 qr. 21 lb.

To stand up to the continuous shock and reversing loads of a rolling mill, a steel casting has to have rock-like strength, toughness and resistance to wear; at the same time it has to be cast into intricate shapes. This combination of properties is possessed by no other material.

That is why Edgar Allen steel castings in carbon or alloy steels are specified for rolling mills, crushing and grinding machinery and many other purposes where plant has to stand up to really hard work.

Why not consult us in the early stages of design of any such machinery? Edgar Allen Steel Foundry is one of the best equipped in the country, backed by a fund of experience in the requirements of steel castings users.

EDGAR ALLEN STEEL CASTINGS

Edgar Allen & Co. Limited
IMPERIAL STEEL WORKS · SHEFFIELD · 9

For this Booklet post the coupon to-day

To EDGAR ALLEN & CO. LTD. SC18/MY
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Please send details of Edgar Allen Steel Castings to:

Name .....
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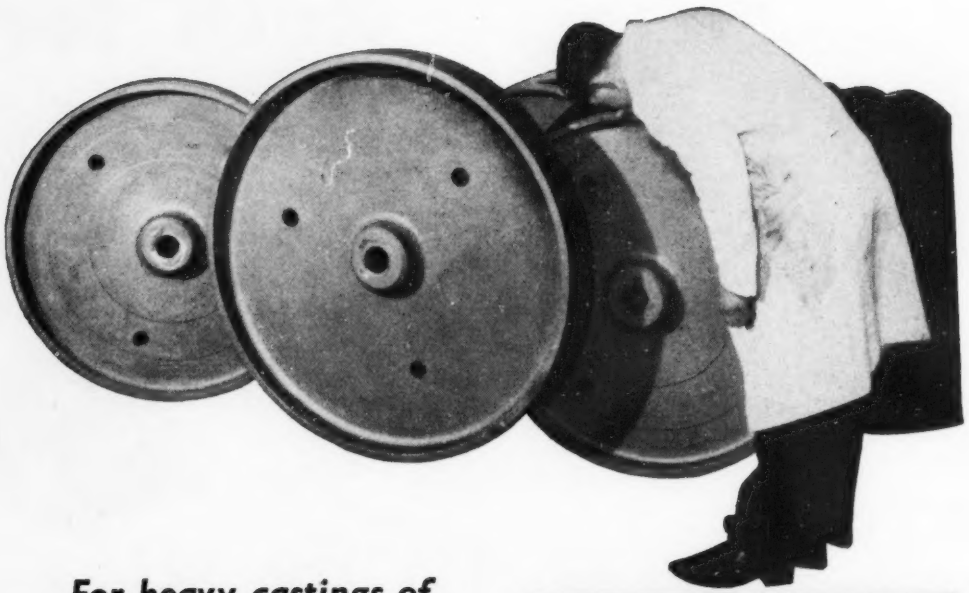

For heavy castings of special properties or for small repetition work . . .

HARPER CASTINGS

Each of these 12 cwt. band saw wheels handles 120 h.p. and the peripheral speed is in excess of 9000 ft. per minute! As the customer required them to be *machined all over*, all surfaces had to be completely free from defects, hard spots and cavities.

Right: Lock cover weighing 9 oz., with a fine skin finish.

Harper quality covers Grey Iron, Spheroidal Graphite Iron (Mond Nickel Licence) and Meehanite castings. Also Metal Pressings, machining, enamelling and other finishes and sub-assembly work.

CASTINGS WITH THE HARPER SKIN

JOHN HARPER & CO. LTD. JOHN HARPER (MEEHANITE) LTD.
ALBION WORKS Phone: WILLENHALL 124 (5 lines) Grams: HARPERS, WILLENHALL **WILLENHALL**

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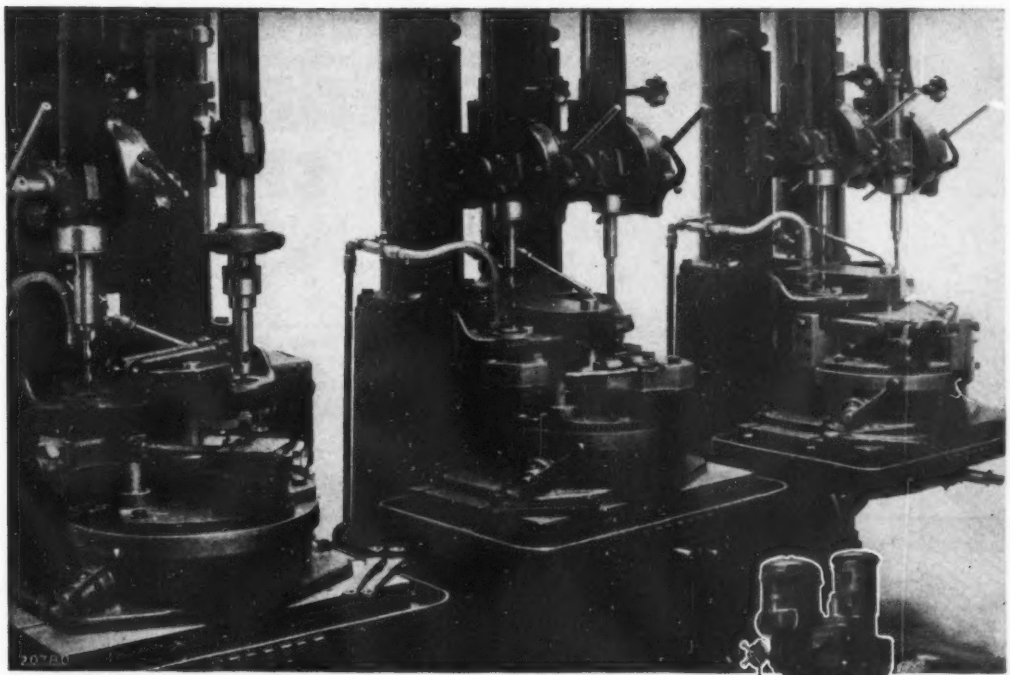
MANCHESTER OFFICE: c/o B. J. Brown & Partners Ltd. 248/9 Royal Exchange, Manchester 2 H643

HERBERT *all-electric Drilling Machines*



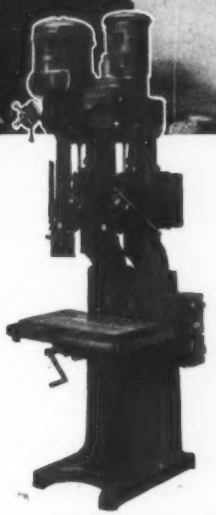
(above) Line of three Type V 2-spindle Drilling Machines each equipped with an indexing fixture for high production of bicycle cranks. The operations include drilling and reaming cotter-pin and bottom-bracket spindle holes and drilling and tapping the pedal hole. Right- and left-hand cranks accommodated; production—six cranks completed every 9½ minutes.

Unit construction of Herbert All-electric Drilling Machines provides a very wide range of machines without recourse to specialisation. The range is sufficiently extensive to meet the demands of most general-purpose machines and to provide a basis from which to build special-purpose machines.

Top columns can be supplied to customers for fitting to their own bases.

These drilling machines incorporate many labour-saving devices and can include such refinements as automatic reversing attachment for tapping, quick-change drill chuck and automatic feeds. Most types are fitted with a drill-depth indicator; automatic feeds and alternative range of speeds are offered.

There are eight types for drilling holes from the very smallest, at 18,000 r.p.m., up to 1¼" diameter, and all usual tapping requirements up to the same capacity.



(above) Type V and C top columns automatic feeds, on a common base. Twelve speeds 36 to 2850 r.p.m.

All types available for Early Delivery

ALFRED HERBERT LTD., COVENTRY

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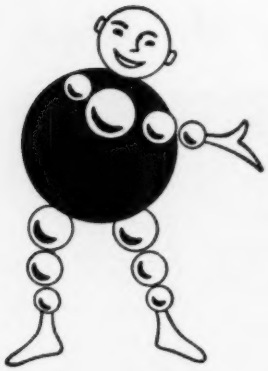


TILGHMAN'S WHEELABRATOR STEEL SHOT

Is the Perfect Answer to

	T	H	E		P	U	Z	Z	L	E
O	F		A	B	R	A	S	I	V	E
		S	E	L	E	C	T	I	O	N

In the short time that Wheelabrator Steel Shot has been available in this country we have been able to satisfy users of this new abrasive that they can effect a saving of at least 33⅓ per cent on their overall shot blast costs.

For example, on one Wheelabrator installation, 800 hours continuity of production was recorded without any change of wheel components or wearing parts.

We guarantee to prove a substantial overall saving on existing shotblast costs to any operator of shotblast equipment, on an initial trial basis and if our claims are not fully justified, no charge will be made for the shot supplied.

Contact us today, we know it will be to your advantage.

USERS have KIND WORDS, not CROSS WORDS for WHEELABRATOR STEEL SHOT

SOLE LICENSEES IN GREAT BRITAIN

TILGHMAN'S LIMITED

A member of the Stavely Coal & Iron Co. Ltd. Group

BROADHEATH · ALTRINCHAM · CHESHIRE

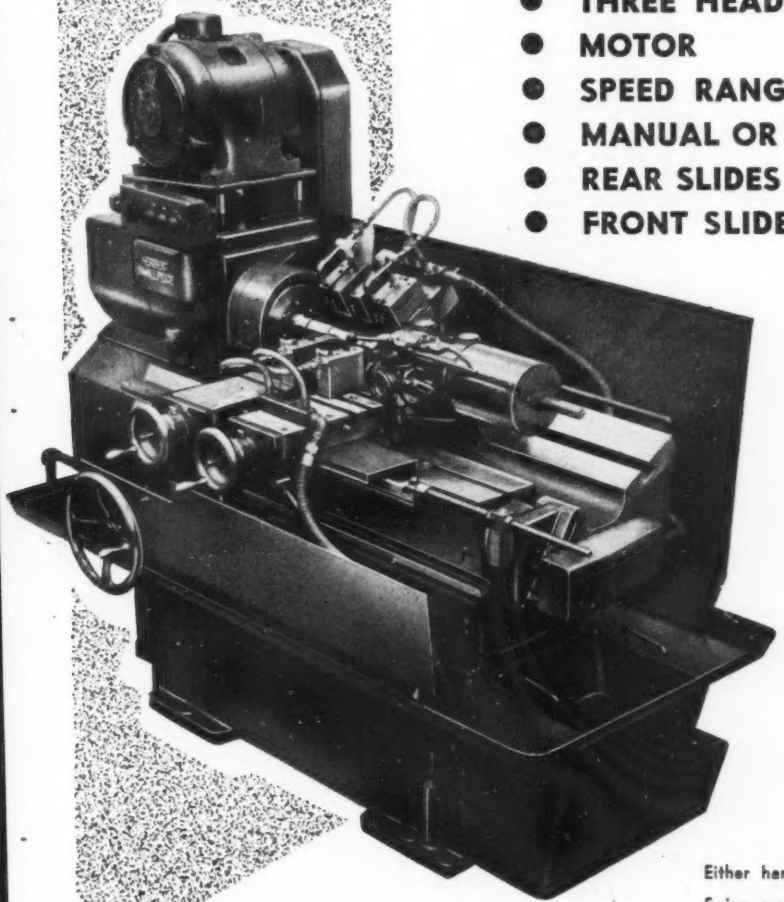
W.144

The most versatile multi-cut Lathe

HERBERT-SMALLPEICE

with a choice of . . .

- THREE HEADSTOCKS
- MOTOR
- SPEED RANGE
- MANUAL OR AUTOMATIC CYCLE
- REAR SLIDES
- FRONT SLIDES



A unit-constructed machine which enables tooling for wide variety of long and short components to be arranged quickly in any combination by means of slides and attachments.

Either hand or automatic cycle control

Swing over bed ... ... 12"

Admits between centres ... ... 29"

ALFRED HERBERT LTD., COVENTRY

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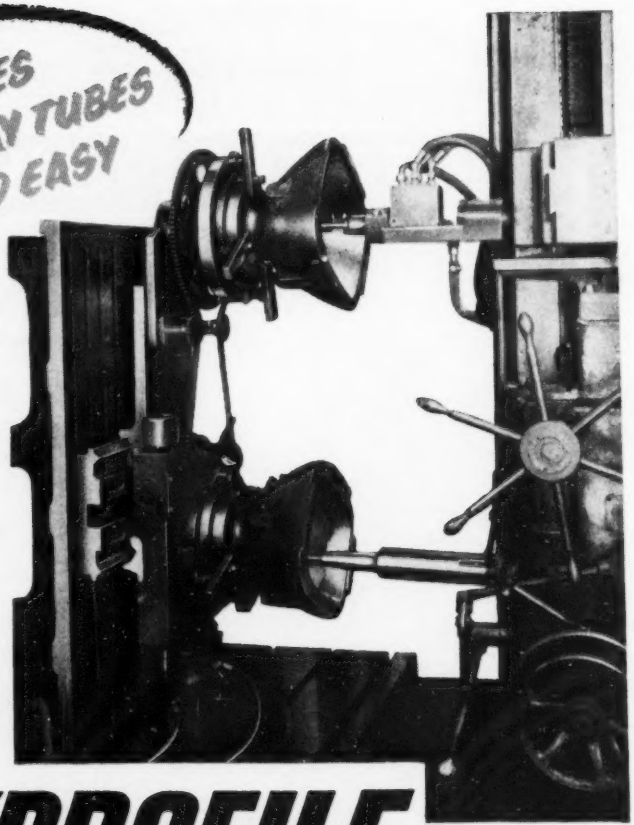

The illustration shows the Hyprofile rotary milling equipment on a horizontal boring machine doing three-dimensional internal milling.

—The HYPROFILE

OUTSTANDING FEATURES

1. A Universal Hydraulic Duplicator for Lathes, Shapers, Planers, Boring and Grinding Machines.
2. Low cost duplicating of parts or contours on the face, diameter, or bore.
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A complete portable unit easily fitted to any standard machine tool — proved on production

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Max. dia. of hole ..... 10"
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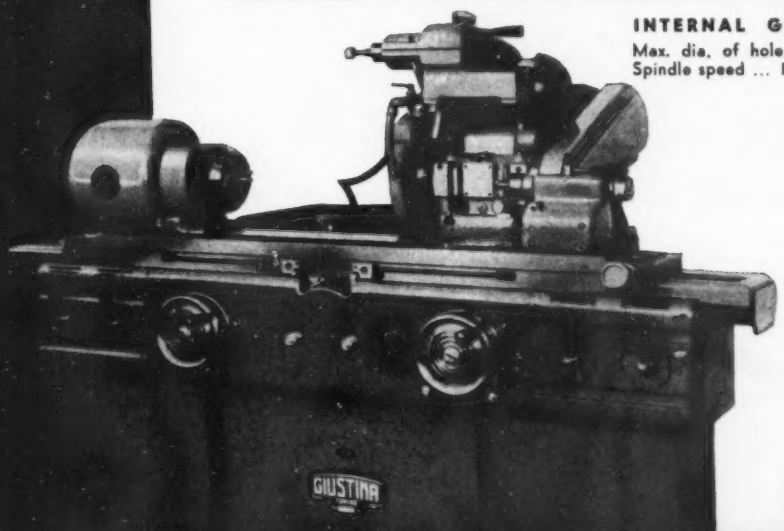

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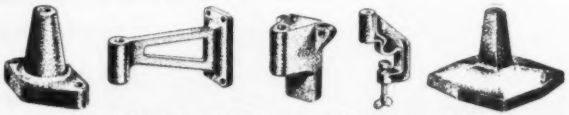
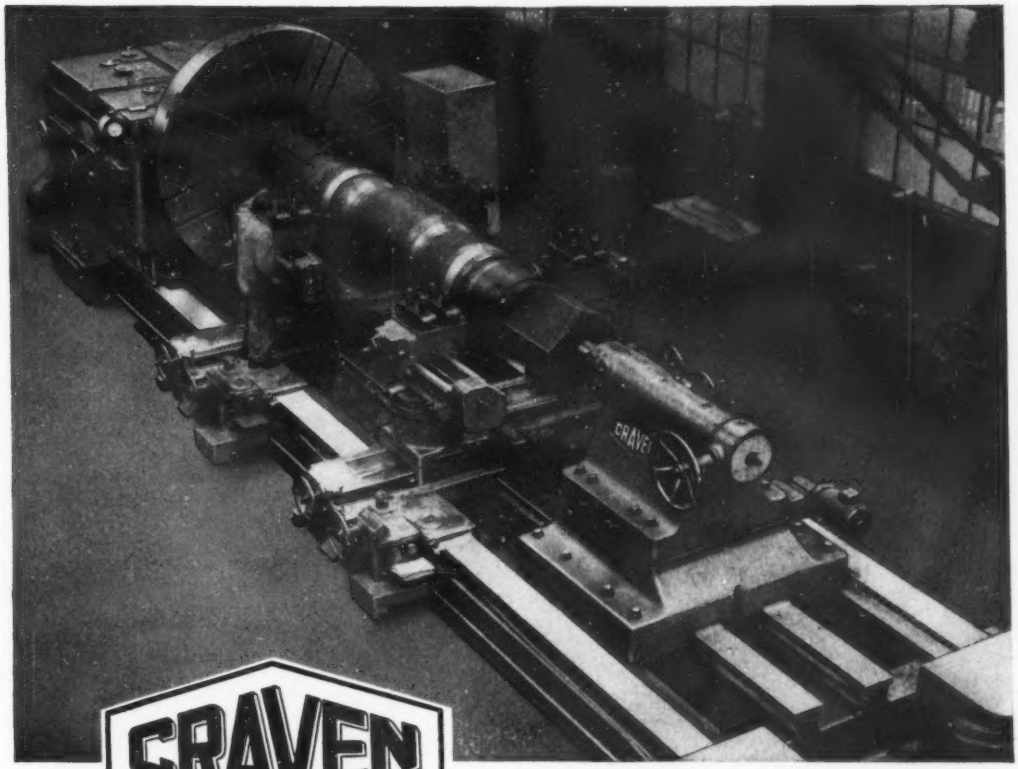


Some of the alternative bases for all models

HT20B



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From 16in. to 100in. Height of Centres

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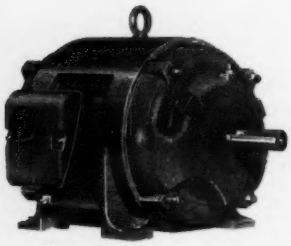

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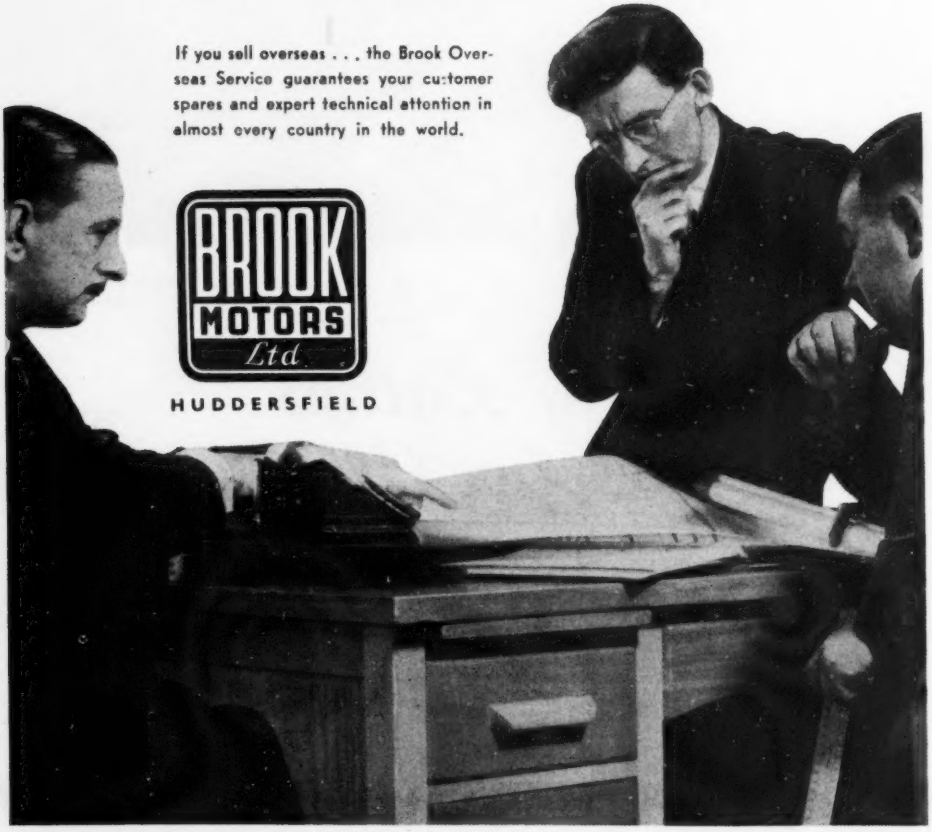

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Pneutomation never forgets to operate

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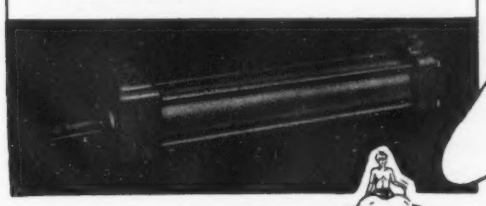

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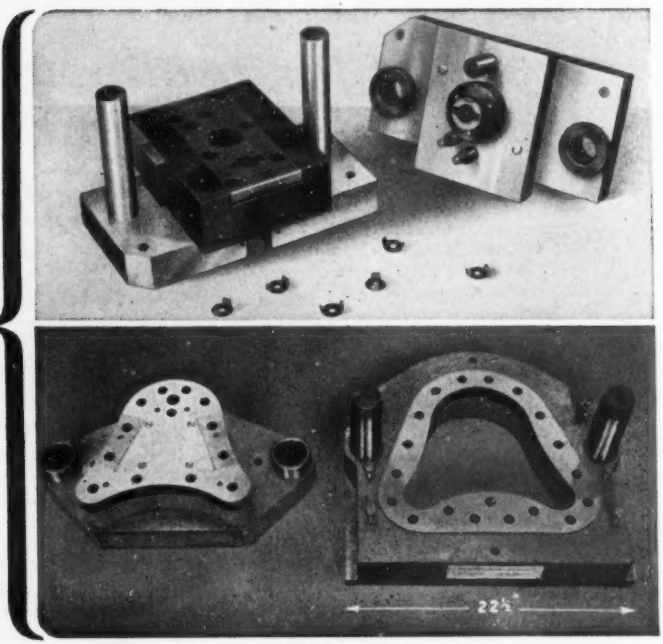

BECAUSE of its high chromium and carbon content, 476 Steel resists wear and is specially suited for exacting punching and forming operations on abrasive materials. It has also considerable toughness, the tool edges standing up to shock applications, such as heavy punching and shearing. The photographs illustrate two contrasting applications. (Top) Three stage press tool for punching and forming clamping washers from brass strip (courtesy, Clarke Chapman & Co. Ltd.). (Bottom) Heavy press tool for blanking hoist bracket in ⅛" thick mild steel (courtesy, Stothert & Pitt Ltd.). 476 is air hardening and machinable in the annealed condition. Applications include blanking dies and punches for sheet brass, copper, zinc, high silicon transformer steels and hard abrasive materials generally; blanking tools for steel sheet and plate; blades for flying strip shears and plate shears; deep drawing dies, cupping dies, forming dies; sheet metal forming rolls; circular cutters for strip; trimmer dies, thread rolling dies; gauges and other precision tools; taps, staybolt taps; brick mould liners; master hobs for cold hobbing plastic moulds; cut moulds for plastics.

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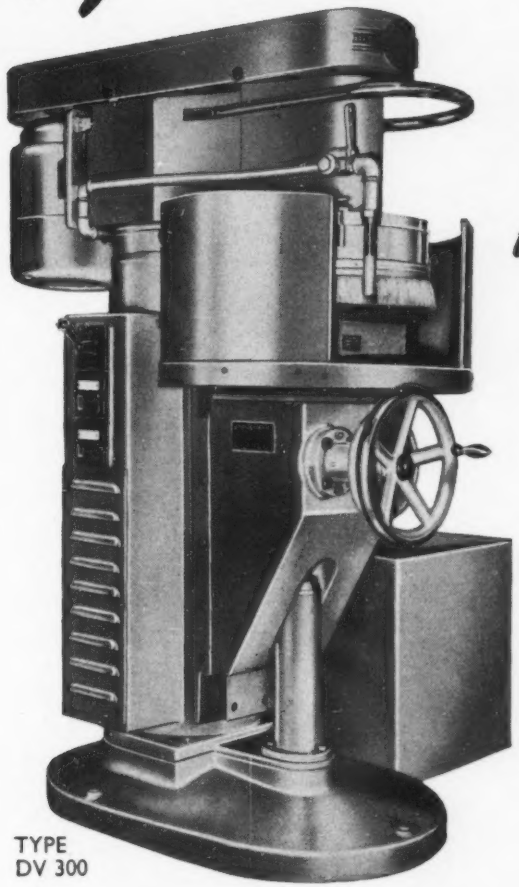
High Speed STOCK REMOVAL

DISKUS

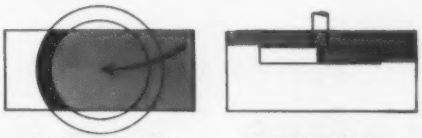
SWIVEL HEAD SURFACE GRINDER



TYPE
DV 300

ENTIRE WORKPIECE SURFACE GROUND IN ONE WORKPASS

The superior stock removal capacity of the segmental grinding wheel shortens grinding time to a fraction of that taken by peripheral grinding owing to the small area of contact with the workpiece.



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MANY TRAVERSES WITH PERIPHERAL GRINDING

Balanced swivel arm, mounted on heavy duty anti-friction bearings fitted to amply dimensioned column, ensures smooth and easy movement.

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Diameter of Segmental grinding wheel 12"
Chucking surface of work table 16" x 8"
Vertical adjustment handwheel graduated in ·0002"

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This machine is only one of the many different models of the standard and special segmental wheel grinders made by the Diskus Company.

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DV 300

A Proved JIG BORER

-at an attractive price!

THE MODEL VL600 aba

Optics by Leitz
Power Feed to Spindle
Covered ways

Large Selection of Extra Equipment Available

Brief Specification

Area of table	16" x 26"
Longitudinal Travel of table	26"
Cross Travel of table	17"
Number of spindle speeds, geometric progression ratio 1.41 ...	12
Spindle Speeds	31–1500 r.p.m.
8 Power feeds	·0015"–·017" p. rev.

12 page Booklet will be sent on application to Sole Agent!

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THE BESCO MODEL TV0 ECCENTRIC PUNCHING PRESS

is ideally suited for blanking, forming and punching with a maximum pressure of four tons. A new type of clutch with patented operating latch (patent number 728614) will relieve you of clutch worries. It will also give you continuous running or single stroke action depending on your needs. Adjustable stroke 1/4in. to 1in. suits many tools: there is also plenty of daylight between bed and ram. The bed area is 59 sq. in.

To suit your purpose, the press is supplied on a floor stand for motor drive or for bench or stand mounting for lineshaft drive.

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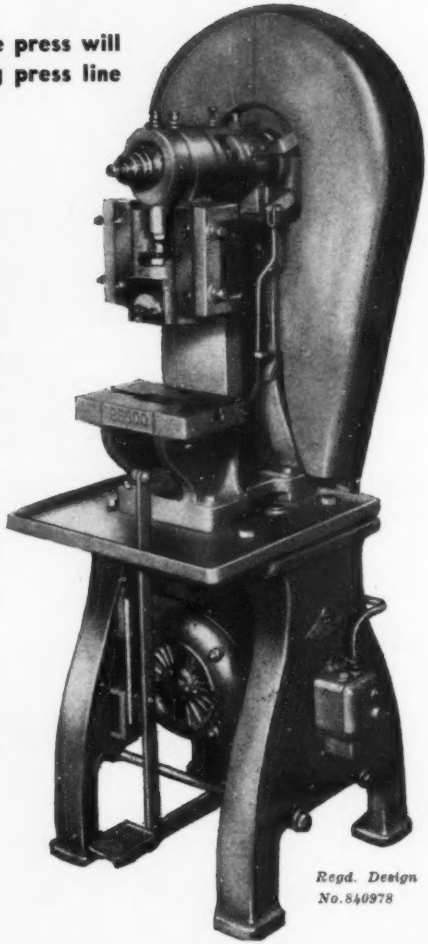

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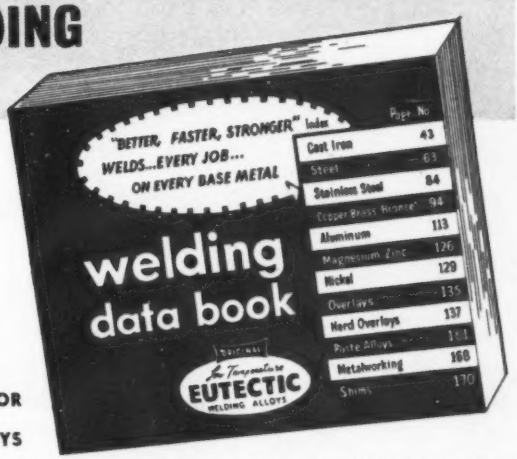

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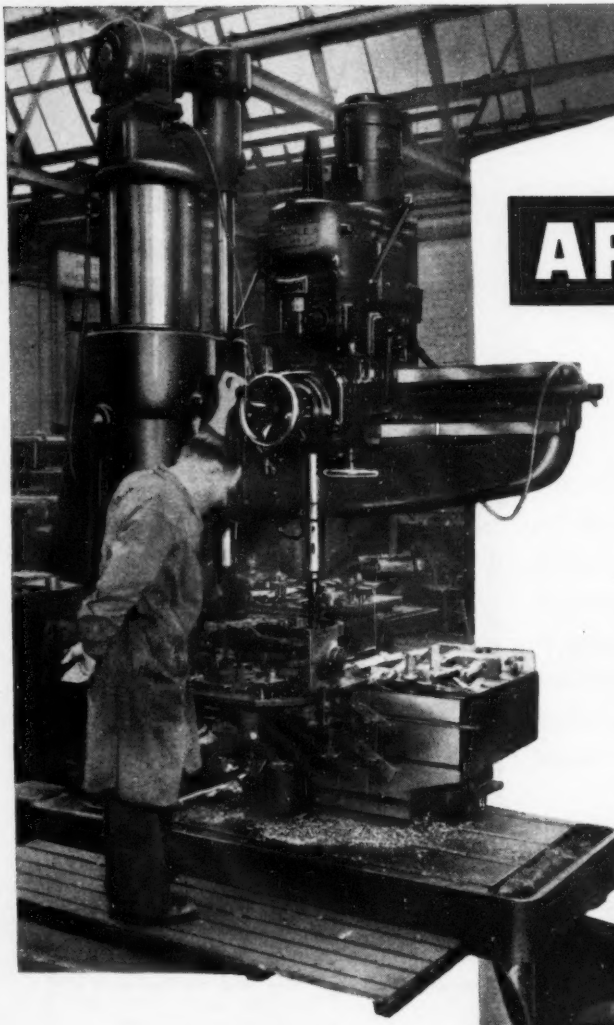

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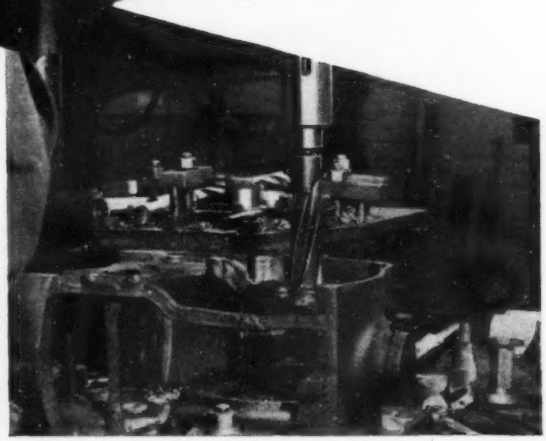

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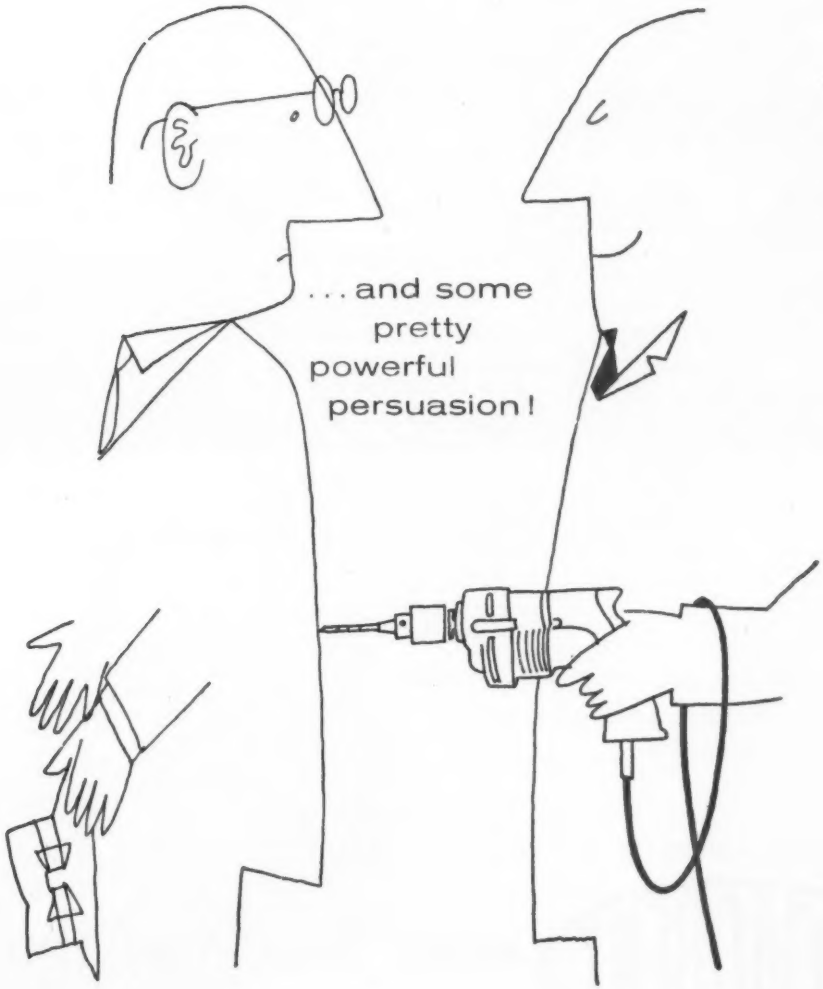

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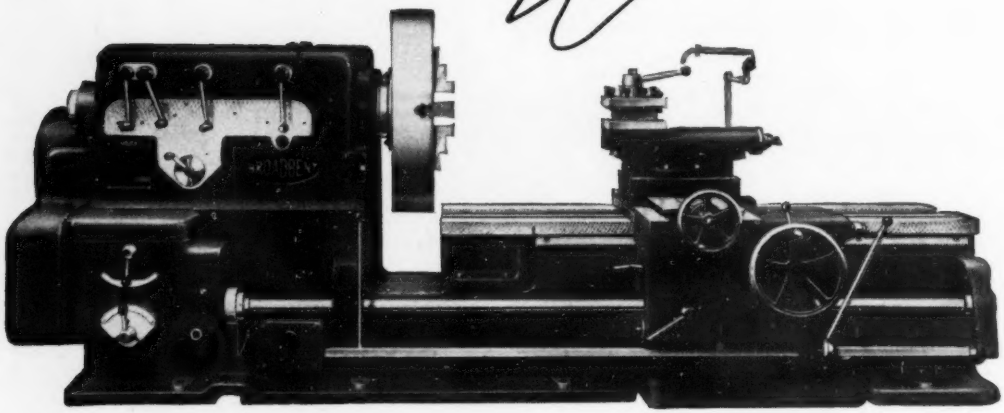

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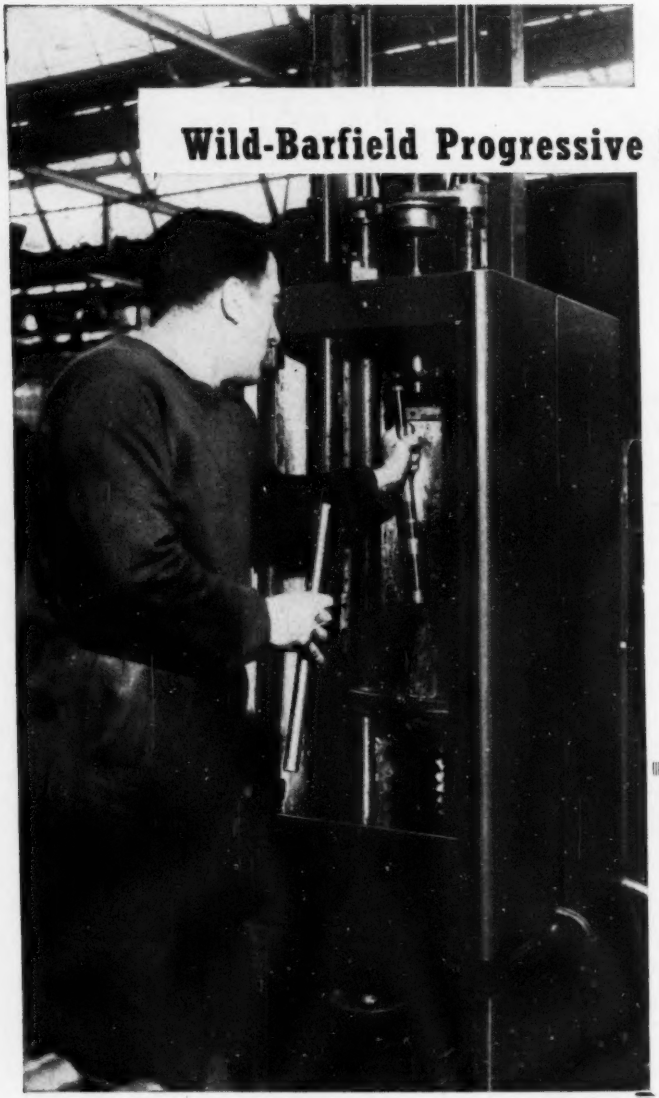

Wild-Barfield Progressive Hardening Machine at MORRIS Engines Limited

Hardening of valve rocker shafts at Morris Engines Ltd., is carried out on Wild-Barfield Progressive Hardening Machines. (Note the hardness pattern on the rocker arm that is being removed.) This is a typical application of this proved unit of the well-known Wild-Barfield range of induction heating equipment.

Some technical facts.

This fixture caters for lengths from 1" to 30", or longer in special cases, diameters from ½" upwards depending on the size of Wild-Barfield A.H.F. Generator used. A simple cam change enables any desired hardness pattern to be obtained giving hard and soft zones as required. The construction follows machine tool practice and incorporates traverse speed control which, together with power control on the generator, makes the equipment extremely versatile.

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WILD BARFIELD A.H.F.

INDUCTION HEATING SPEEDS PRODUCTION

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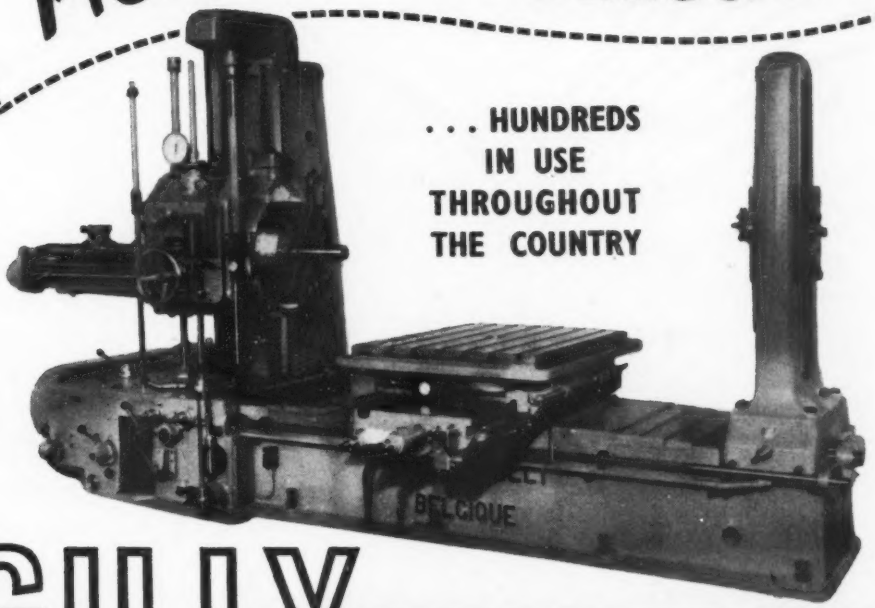

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Spindle diameter	2¾in.	3¼in.	4in.	5¼in.	6¼in.
Facing capacity	19¾in.	29¼in.	39¼in.	49¼in.	57in.
Speed range	10-1,250 r.p.m.	9-1,100 r.p.m.	5-975 r.p.m.	4-700 r.p.m.	2·9-500 r.p.m.
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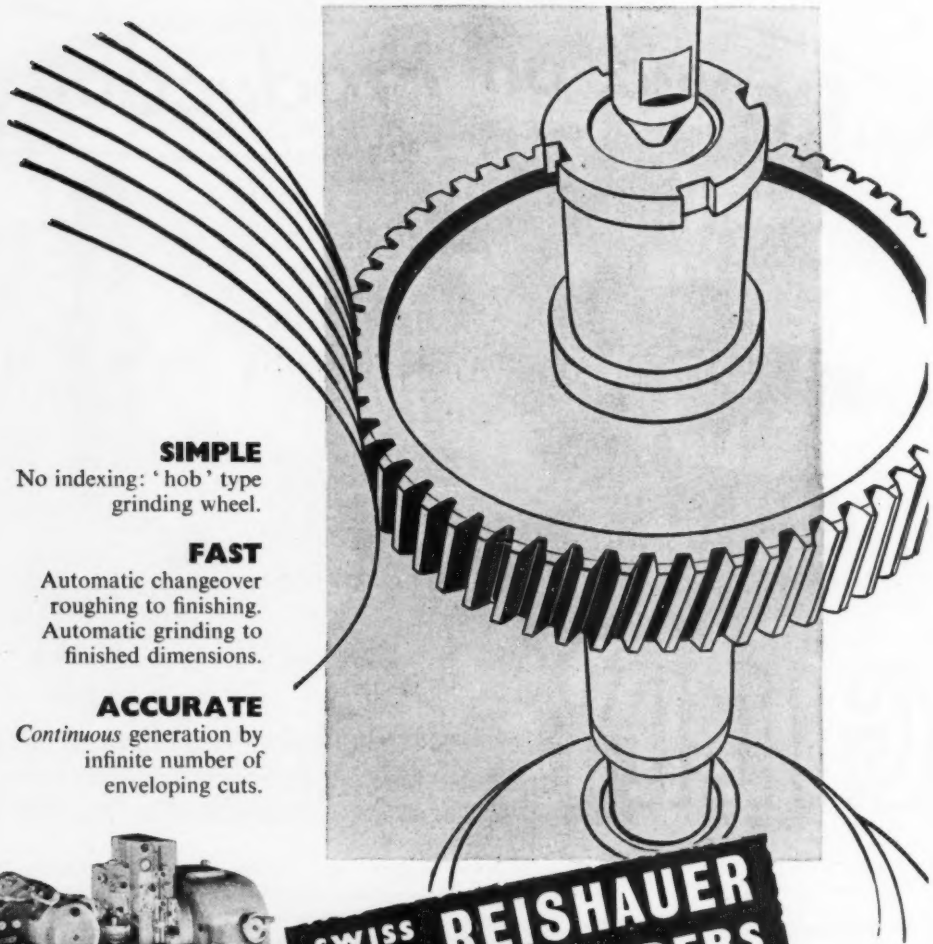

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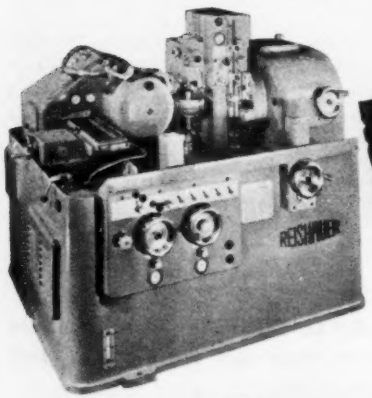
Continuous generation by infinite number of enveloping cuts.



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★ ***SPEEDS UP TO 8,000 R.P.M.***

★ ***CAPACITY UP TO $\frac{1}{2}$in. DIA. IN STEEL***

These units facilitate the building of special high production drilling machines. The heads are entirely self-contained and can be mounted in any vertical, inverted, angular, or horizontal position. Operating cycles are: hand forward hand return—hand forward auto return—auto forward auto return. Capacity up to $\frac{1}{2}$" diameter by $4\frac{3}{4}$" working travel of spindle. Drive by $\frac{1}{2}$ H.P. motor. Robust, precision construction throughout. Also available with Morse Taper quill, suitable for powering multi-spindle drill heads. Write for leaflet.

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Lines Brothers hailed us aboard to pressure die cast their Tri-ang model outboard motor "Swordfish." By helping to simplify the design, we were able to do the job in five aluminium alloy castings, combining lightness and strength. Time, money and labour were saved—as they invariably are when you pick on us. We're ready to produce aluminium or zinc base alloy castings in almost any size or quantity . . . except, if you please, very tiny castings or very short runs.

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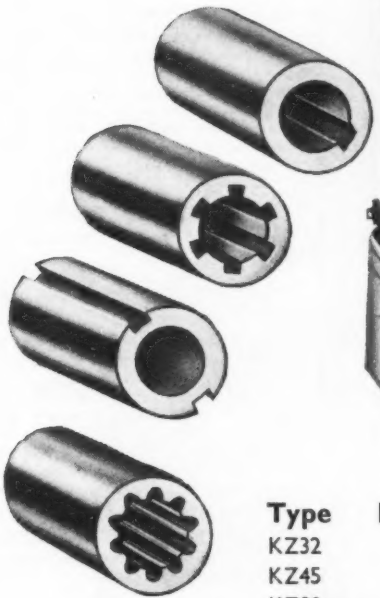

Type	Keyway Width	Max. Stroke
KZ32	$\frac{1}{8}$" - $1\frac{1}{4}$"	$10\frac{1}{2}$"
KZ45	$\frac{1}{8}$" - $1\frac{3}{4}$"	$13\frac{3}{4}$"
KZ90	$\frac{1}{8}$" - $3\frac{1}{2}$"	$21\frac{1}{2}$" - 50"
KZ125	$\frac{7}{8}$" - 5"	59"

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This finish is considered superior to black nickel and can be produced on any plateable metal in either matt, semi-bright or a fully polished finish.

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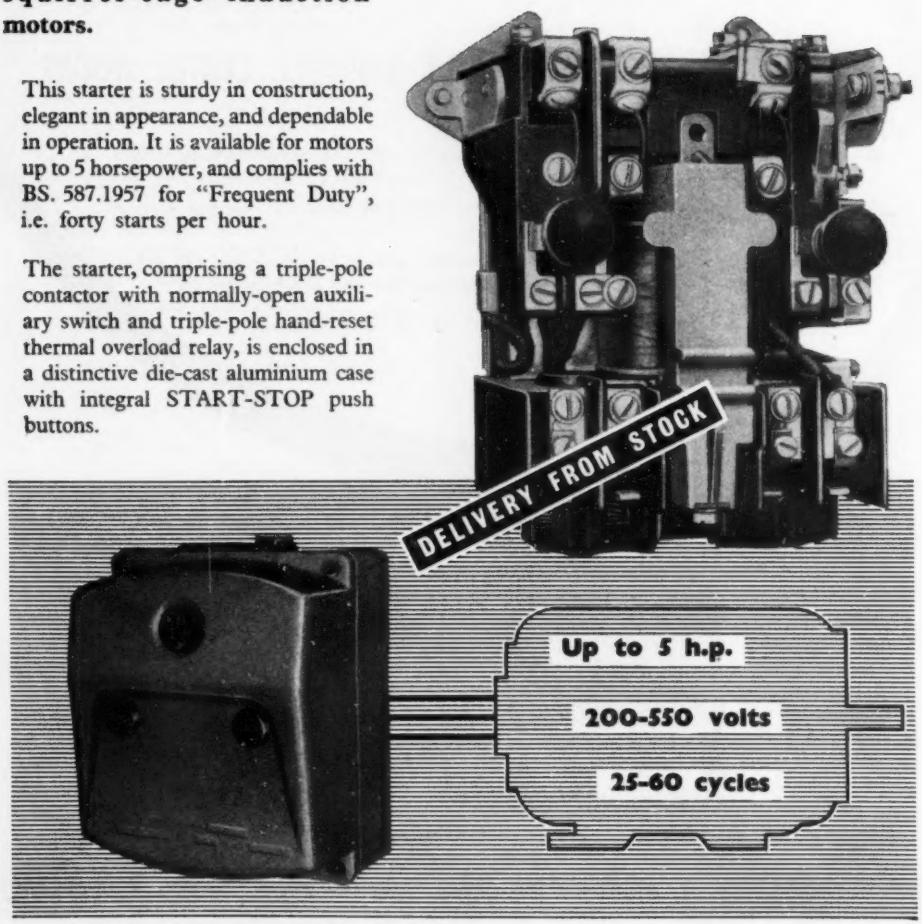
Type DOC 71 for three-phase or single-phase non-reversing squirrel-cage induction motors.

This starter is sturdy in construction, elegant in appearance, and dependable in operation. It is available for motors up to 5 horsepower, and complies with BS. 587.1957 for "Frequent Duty", i.e. forty starts per hour.

The starter, comprising a triple-pole contactor with normally-open auxiliary switch and triple-pole hand-reset thermal overload relay, is enclosed in a distinctive die-cast aluminium case with integral START-STOP push buttons.



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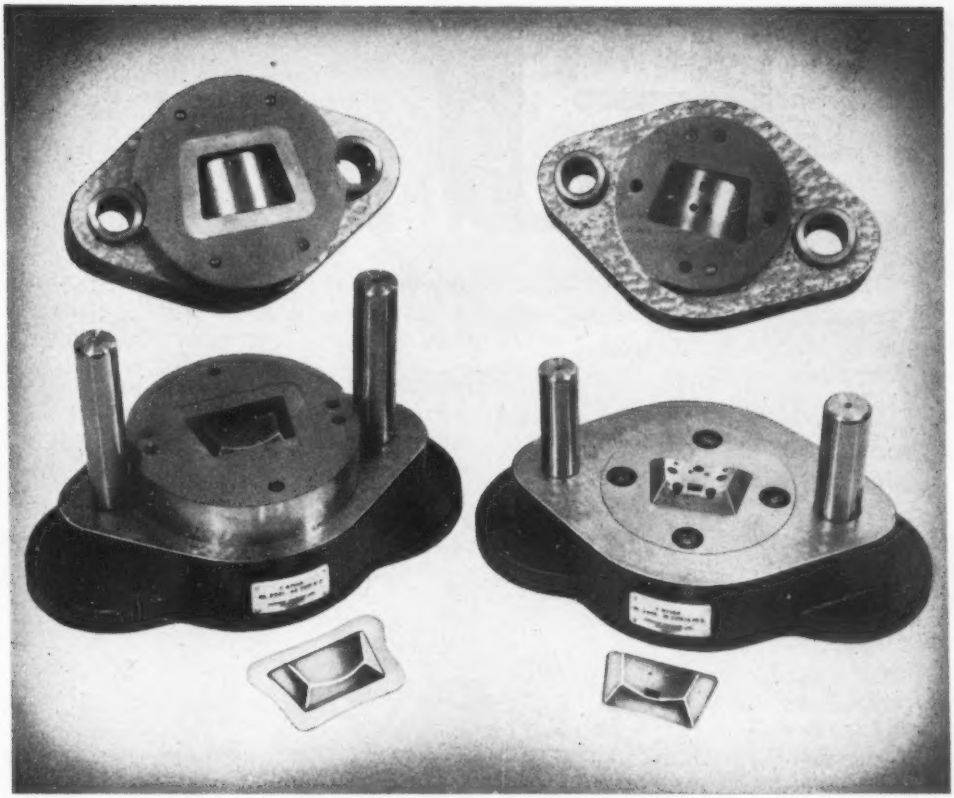

Piercing and Drawing Tools for Alarm Clock Base.
Illustrated by courtesy of S. Smith & Sons (England) Ltd., Wishaw, Lanarkshire.

THOMAS KEATING LTD

Station Mills, Billingshurst, Sussex
Tel: Billingshurst 345
Makers of Press Tools, Gauges, Jigs, Fixtures, etc.

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Ground Thread Taps
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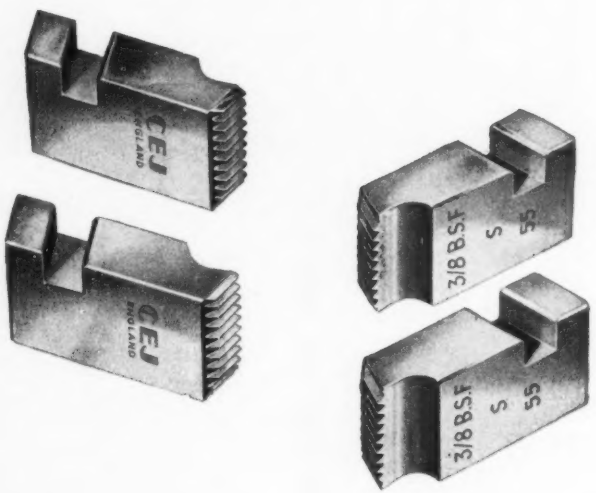
Everything that care and skill can contribute goes to ensuring that CEJ Dies will be correct in every detail and fully meet your requirements.

They are manufactured from specially selected H.S.S. correctly heat treated; produced by the most exacting methods, rigidly inspected in all thread elements and actually tested before despatch.

CEJ Chaser Dies can be used in CEJ 430 Die Heads and Coventry and similar type Die Heads.



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Ground Thread Taps

FOR HIGH PERFORMANCE
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At Charles Winn & Co. Ltd., the Birmingham Valve makers. 'Galtona' Ground Thread Taps are proved entirely dependable for high performance and lasting precision under all conditions of service . . . . on radial drills, capstan lathes, etc. They can be supplied for all types of material, including tough brass and bronze, steel and cast iron, and in all thread forms.

Popular sizes ex. stock. Informative catalogue available on request.

Illustration at top shows the machining of a valve head on a standard valve. Lower illustration is of a boss being tapped on the body of a 6in. cast iron valve, the tapping being 1¼in. B.S.P. Both components are in continual production at Charles Winn's.

Richard Lloyd Limited

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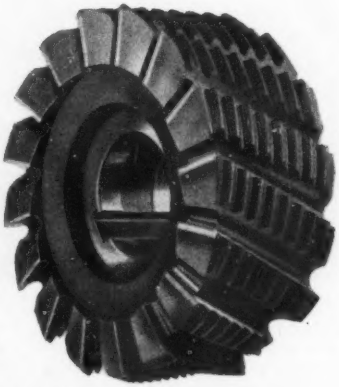
Strasmann Machine Reamers also manufactured from cobalt steel are designed for through hole reaming in all metals. Good finish, straight holes are possible at high production rates. Hole sizes are constant and regrinding does not affect the diameter.



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Sole distributors for Strasmann Roughing Cutters and Reamers in the U.K., would be pleased to send you literature and arrange a demonstration. Enquiries for special requirements are gladly invited.

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FOR UNUSUAL MACHINES

* Two operations 30 seconds !

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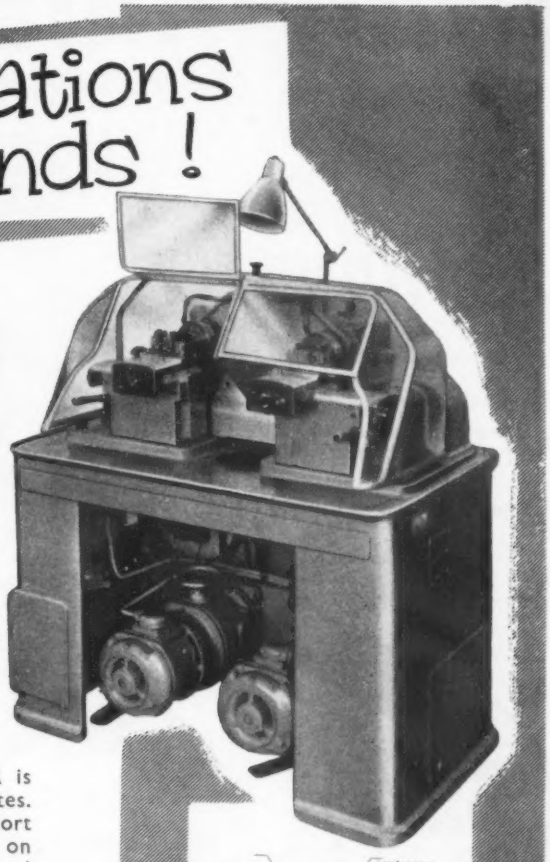
TWO-SPINDLE PROFILING CHUCKING AUTOMATIC

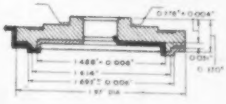
- **DUPLICATE POWER CONTROL FOR OPERATING HEADS INDEPENDENTLY**
- **TOOLS CAM CONTROLLED**
- **PROFILED PARTS MACHINED WITHOUT FORM TOOLS**



As the work example shows, the KUMMER is capable of really exceptional production rates. Tooling costs are low, and easy setting and short change-over times ensure big economies even on short runs. Intricate forms can be produced without special tools. Stepless spindle speeds from 410 to 3500 r.p.m. For non-ferrous turning a model is available with fixed speeds of either 2800 or 3500 r.p.m. Capacity for precision turned parts of any form up to 3.17/32" dia. with a maximum forward stroke of 25/32".

ALSO AVAILABLE: A COMPLETE RANGE OF TURNING MACHINES FOR THE WATCH-MAKING INDUSTRY AND WATCHCASE MANUFACTURERS.

FULL DETAILS FROM DEPT. M.S.



Ratchet Wheel for Calculating Machine. Brass. Cutting Speed :— 1700 f.p.m. Spindle Speed :— 3500 r.p.m. Two Operations :— 30 sec.

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- Wheel dressing diamonds.
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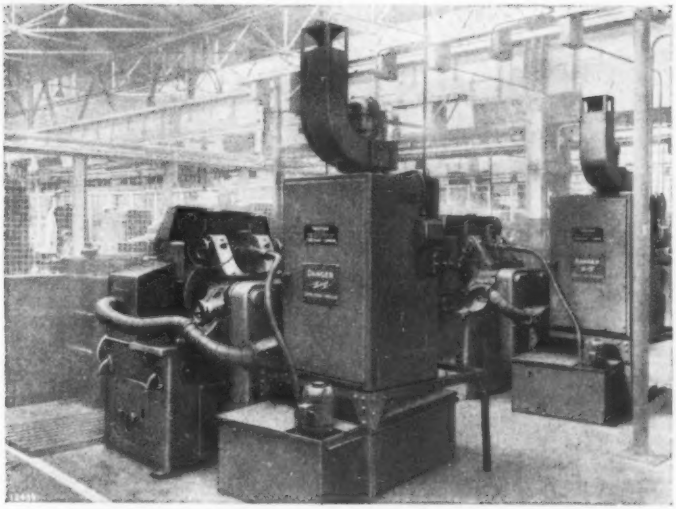

PRECIPITRON Oil Mist Unit applied to a matrix grinder.
Photograph by courtesy of D. Napier & Son Ltd.

Precipitron OIL MIST FILTER

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PRECIPITRON Oil Mist Filter Units will collect oil coolant mist generated by high speed cutting, grinding and other machining operations.

No other type of filter will consistently remove oil mist at such high efficency that:—

- **The filtered air may be safely returned directly to the workshop.**
- **Heat losses are avoided.**
- **Working conditions are improved.**
- **Oil is salvaged.**
- **Damaging effects to machinery, fittings and building surfaces are prevented.**

The only British PRECIPITRON Oil Mist Filter is fabricated and tested by skilled craftsmen in our Manchester Works. It is the finest air cleaner available, and its application is backed by the extensive experience and technical knowledge of Sturtevant engineers in the field of electrostatic air filtration.

A large number have been installed to serve machines singly or in groups.

Further particulars are given in our publication MY. 7106 which is obtainable upon request.

STURTEVANT ENGINEERING CO. LTD.
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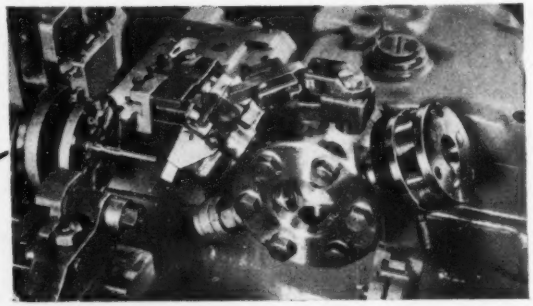
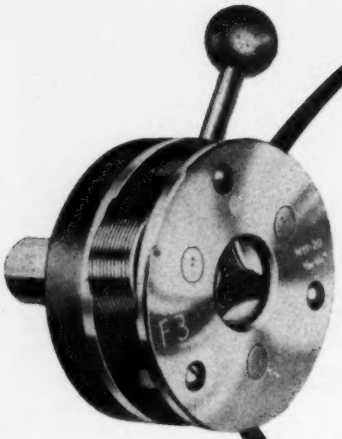
AUSTRALIA

STURTEVANT ENGINEERING CO. (AUSTRALASIA) LTD. 400, SUSSEX STREET, SYDNEY, N.S.W.



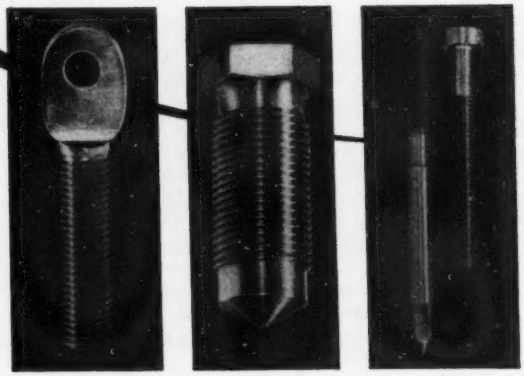


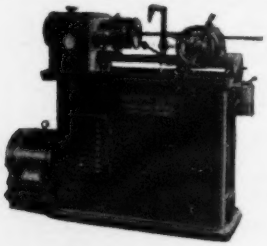
BETTER THREADS MORE QUICKLY FOR LESS COST WITH

MSE—"FETTE"
THREAD ROLLING HEADS

British Patents Nos. 705754, 744039 & 743977

Thread rolling, as opposed to cutting, has enormous advantages * — and can be carried out on your existing lathes, capstans, automatics and drilling machines, with MSE-"Fette" Self Opening Thread Rolling Heads.





MSE-"FETTE" THREAD ROLLING MACHINE

This machine has been designed for use with MSE-"Fette" Heads where volume of threads production calls for a special purpose machine. It is suitable for a range of Heads for threads up to 1¼in. diameter.

* Denser, stronger threads with a hardened surface. Faster, more economic production. Perfect threads on many "unmachinable" materials. Sustained accuracy on long runs. Saving in material costs.

MSE MACHINE SHOP EQUIPMENT LTD., Spenser St., London, S.W.1 Tel.: VICtoria 6086

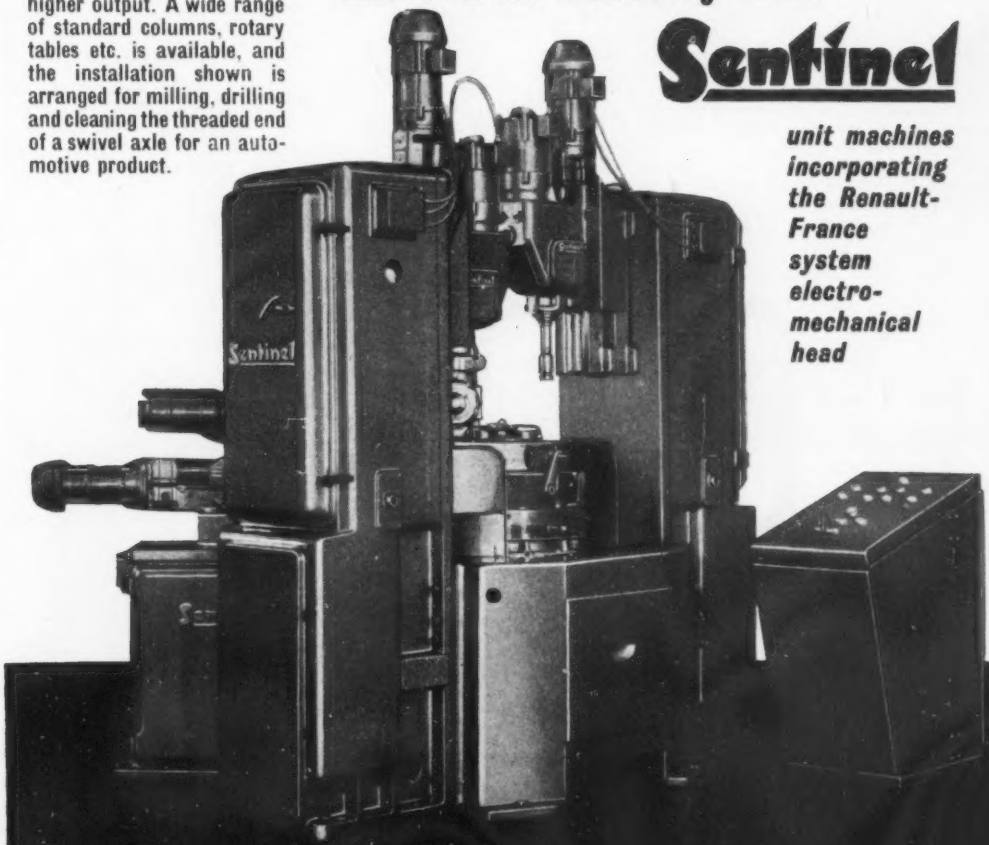
increased output

less time—less rejects —less space—less effort and overall economy with

Sentinel

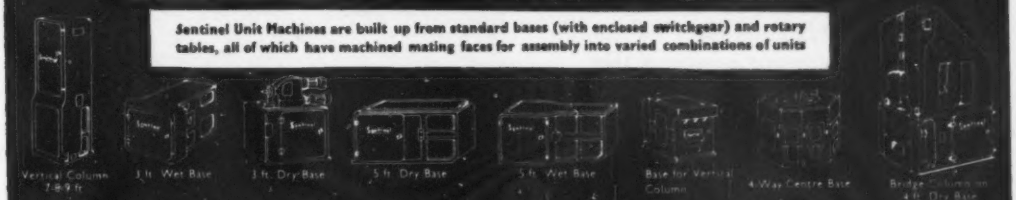
unit machines incorporating the Renault-France system electro-mechanical head

Almost unlimited machining operations are performed by Sentinel Unit Machines, providing improved quantity and higher output. A wide range of standard columns, rotary tables etc. is available, and the installation shown is arranged for milling, drilling and cleaning the threaded end of a swivel axle for an automotive product.



Sentinel *adaptability — versatility — flexibility*

Sentinel Unit Machines are built up from standard bases (with enclosed switchgear) and rotary tables, all of which have machined mating faces for assembly into varied combinations of units

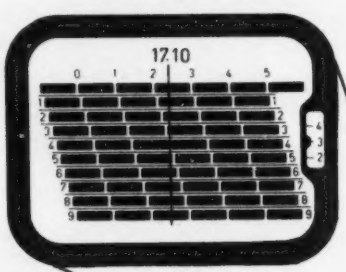

Vertical Column 7-9 ft
3 ft. Wet Base
3 ft. Dry Base
5 ft. Dry Base
5 ft. Wet Base
Base for Vertical Column
4-Way Centre Base
Bridge Column 4 ft. Dry Base

SENTINEL (SHREWSBURY) LTD SHREWSBURY ENGLAND

PERRIN MODEL AV2

JIG BORER with Optical Table

The table may be used for drilling, boring, milling and for measuring, the accuracy being controlled by a new optical system. The easily read optical image assists in rapid and positive setting, and guarantees consistent results free from errors peculiar to lead screws. A special device enables the initial point of measurements to be set at zero. Independently, two rules and pointers are provided for coarse adjustment of the table. Fine adjustment of the table is effected by means of small handwheels acting on the leadscrews through worm reduction gears. The accuracy of reading of the optical system is 0·0001in. and the limit of accuracy of setting the table over the whole range is ±0·00015in. Maximum error of glass rules ±0·00012in.



2 scales as shown controlling longitudinal and transverse settings

Swiss made—reasonably priced

SPECIFICATION

Boring capacity in cast iron 4in.
Travel of spindle 4⅝in.
Infinitely variable speeds up to 3,200 r.p.m.,
three-power feeds to spindle (0·002in.,
0·004in., 0·008in.)
Table size 19⅝in. by 11in.
Longitudinal movement 16in.
Transverse movement 11in.

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ACBARS LTD

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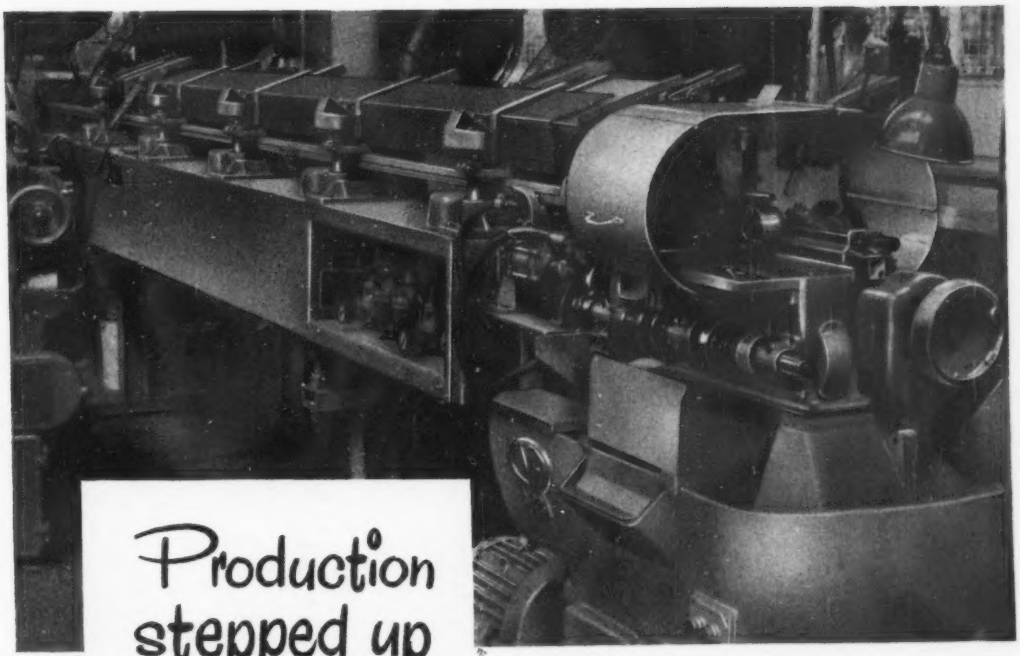
Telephones : CENtral 2287-8-9, 6811-2



Production stepped up 30% to 100%

BY ELIMINATING IDLE TIME

LIPE

FULLY AUTOMATIC PNEUMATIC BAR FEED

cuts costs on auto screw machines — *NEW or OLD*

The LIPE Bar Feed scores its great advantage by reducing idle machine time. After installing the LIPE system you have no need to stop the machine for loading fresh bar stock or locating the bar end for the first part-off, the entire bar stock being fed automatically from the magazine right down to the last workpiece length. When the portion of bar stock remaining in the collet is insufficient for the next component the automatic disengagement of a clutch stops the tool cycle with spindle running and collet open ready for the new stock bar to eject the remnant and continue the cycle. New stock is fed out to a predetermined length so as to restrict stock wastage to a minimum. There are no awkward control trips to set—you'll find that LIPE Bar Feeds make your automatics *really automatic!*

Write for full details to Dept. M/12.

PATENTS. Nos. 728898, 743461 AND 23176/57.

LIPE ROLLWAY

Automation Ltd.

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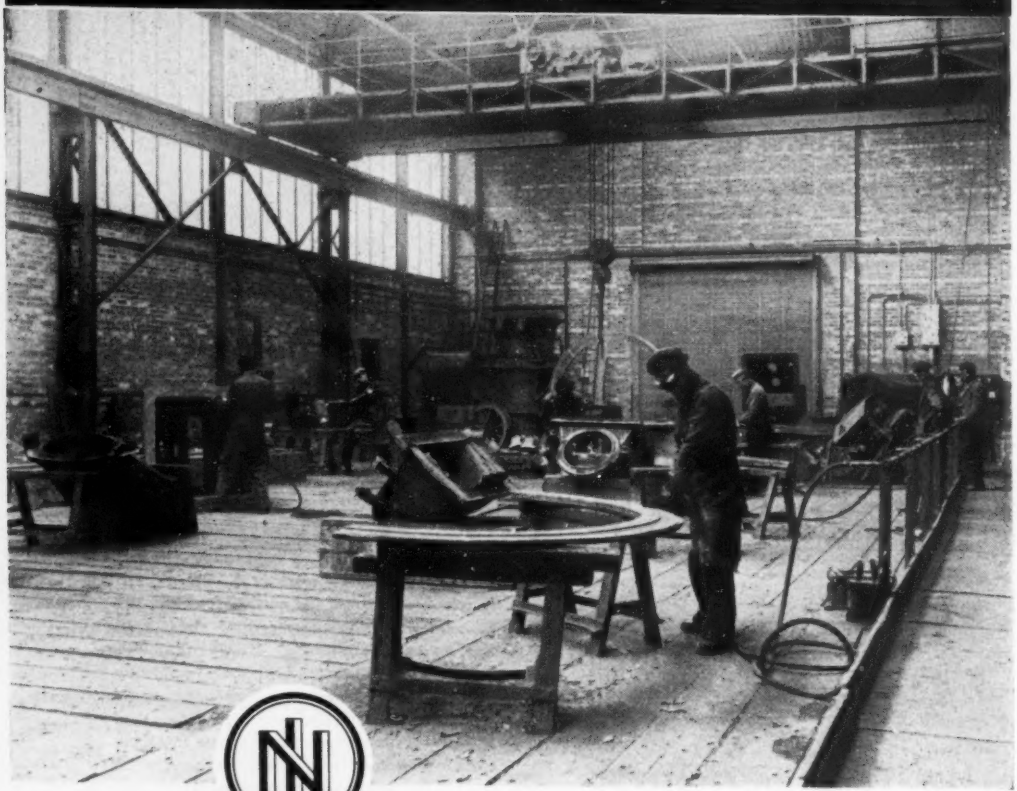
NEWTONS FOR QUALITY CASTINGS

GREY IRON · HIGH DUTY · ACID RESISTING · HEAT RESISTING



THE MARK OF QUALITY

All types of CASTINGS supplied from ounces up to 10 tons weight, from drawing to finished article in unit or quantity production

Photograph shows a section of the Modern Dressing Shop recently installed, with castings being finished prior to machining or despatch to customers

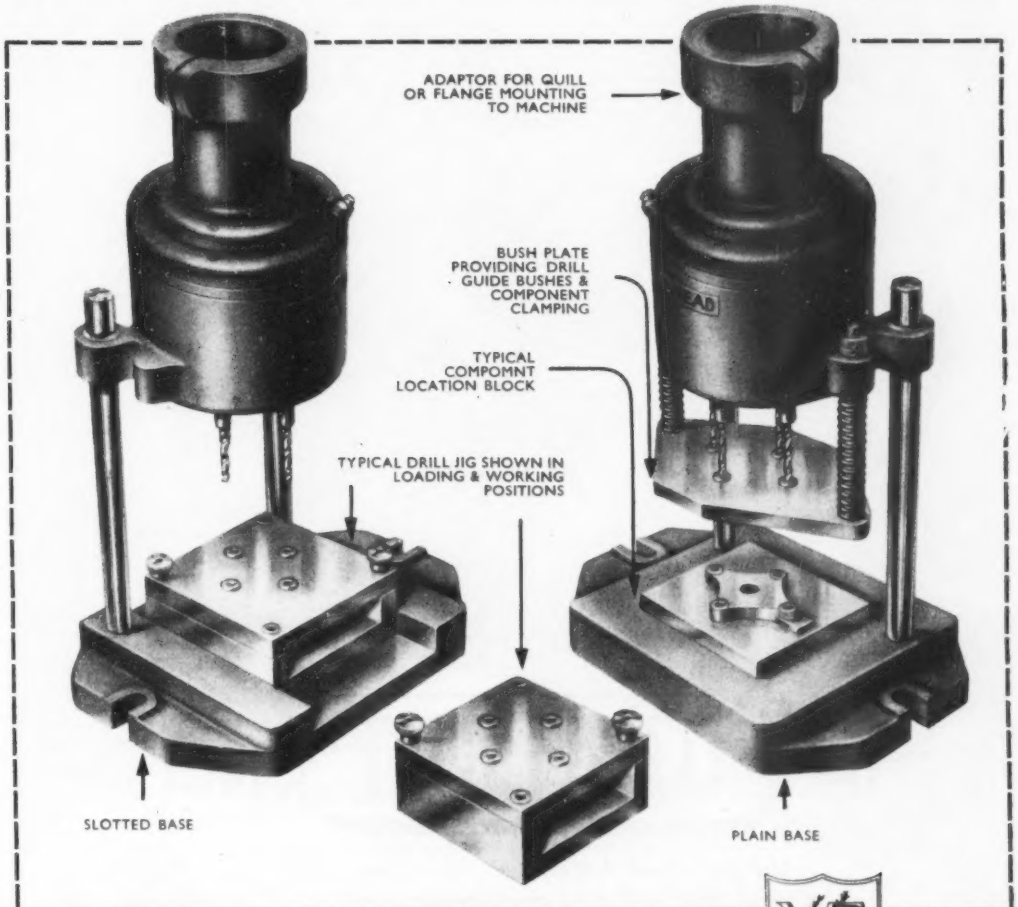
NEWTONS (IRONFOUNDERS) LTD · MILES PLATTING · MANCHESTER 10

Telephone : Collyhurst 1984 (3 lines)

MULHEAD *standardised*

MULTI-SPINDLE DRILLING & TAPPING SETS

NOW AVAILABLE IN $\frac{3}{16}$in. TO $\frac{3}{8}$in. CAPACITY—$2\frac{5}{8}$in. TO $10\frac{1}{2}$in. P.C.D.


ADAPTOR FOR QUILL OR FLANGE MOUNTING TO MACHINE
BUSH PLATE PROVIDING DRILL GUIDE BUSHES & COMPONENT CLAMPING
TYPICAL COMPOMNT LOCATION BLOCK
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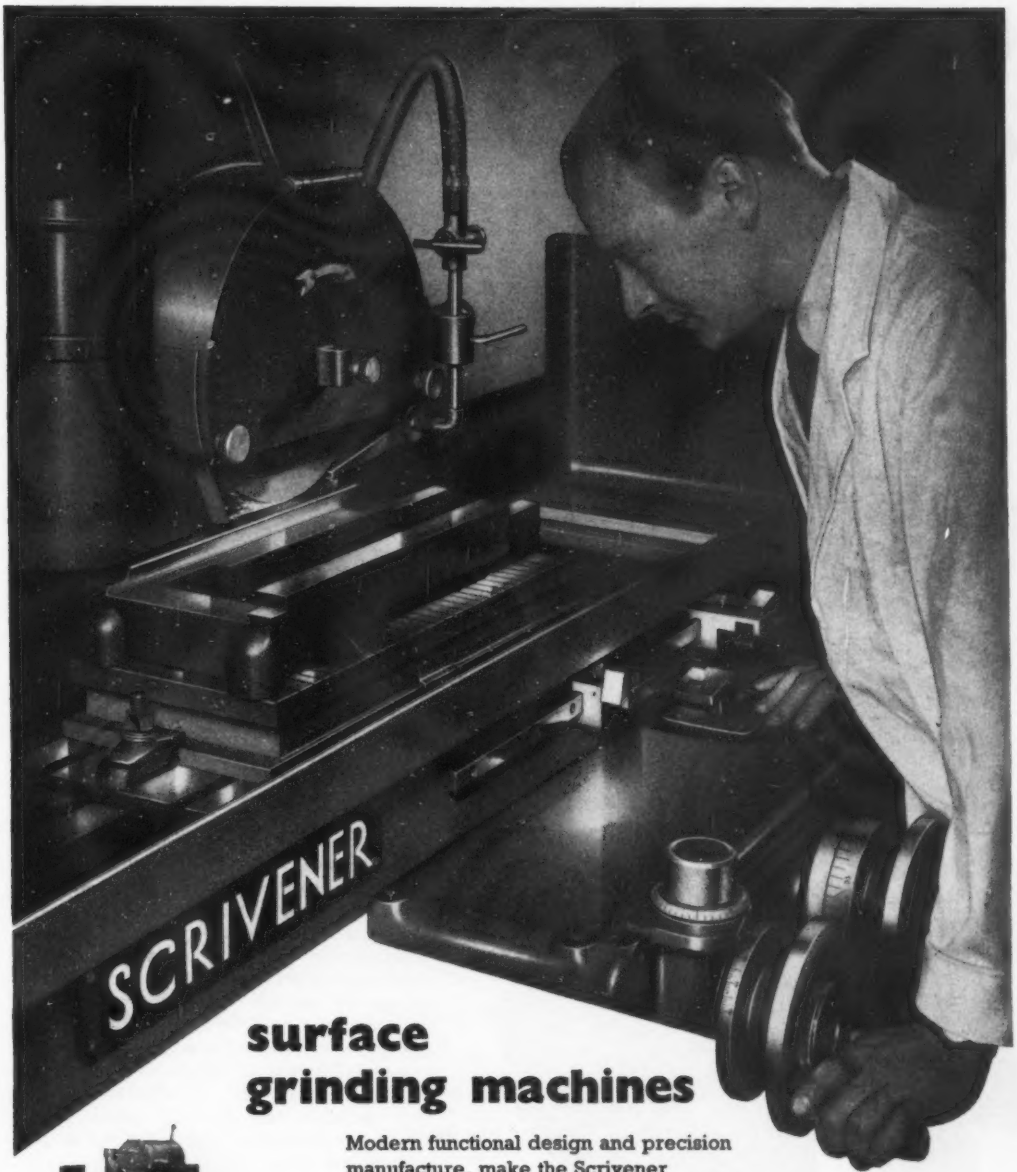
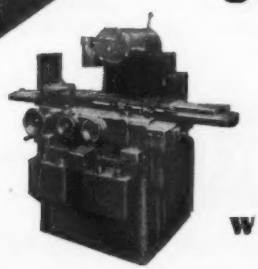


surface grinding machines



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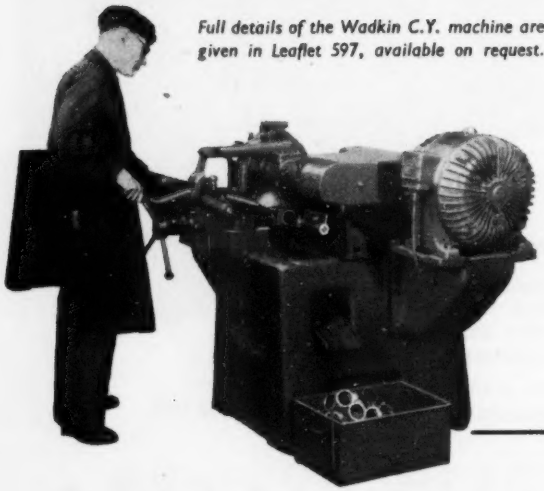

Full details of the Wadkin C.Y. machine are given in Leaflet 597, available on request.

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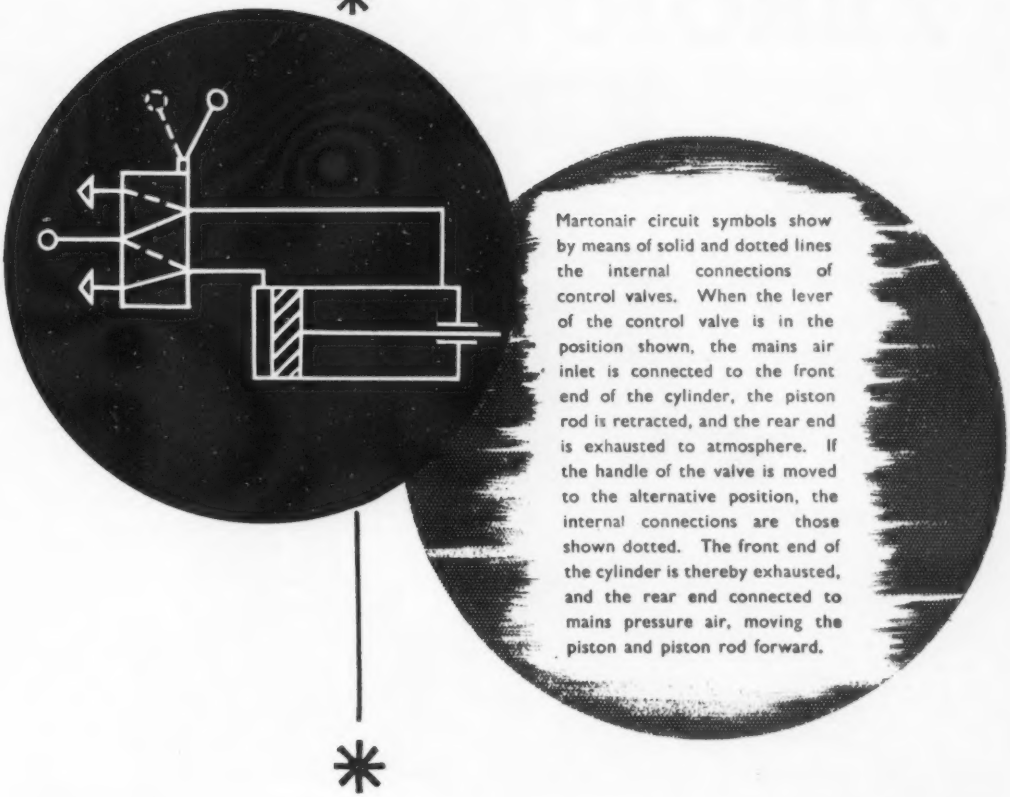
Martonair circuit symbols show by means of solid and dotted lines the internal connections of control valves. When the lever of the control valve is in the position shown, the mains air inlet is connected to the front end of the cylinder, the piston rod is retracted, and the rear end is exhausted to atmosphere. If the handle of the valve is moved to the alternative position, the internal connections are those shown dotted. The front end of the cylinder is thereby exhausted, and the rear end connected to mains pressure air, moving the piston and piston rod forward.

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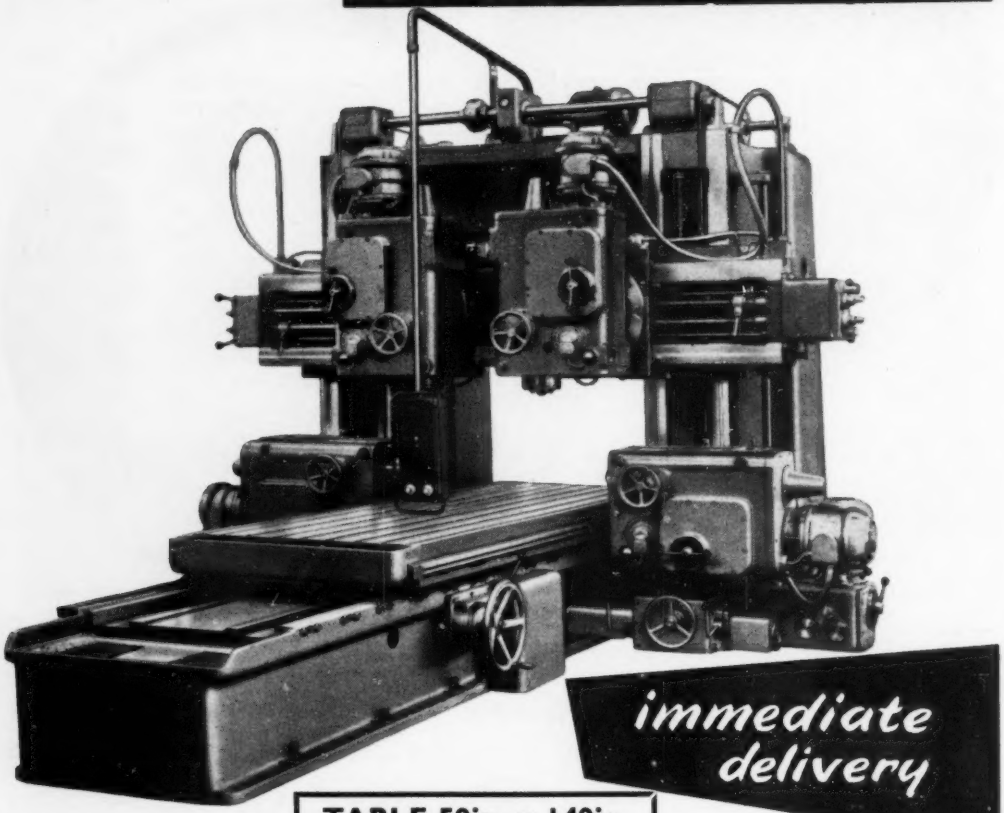

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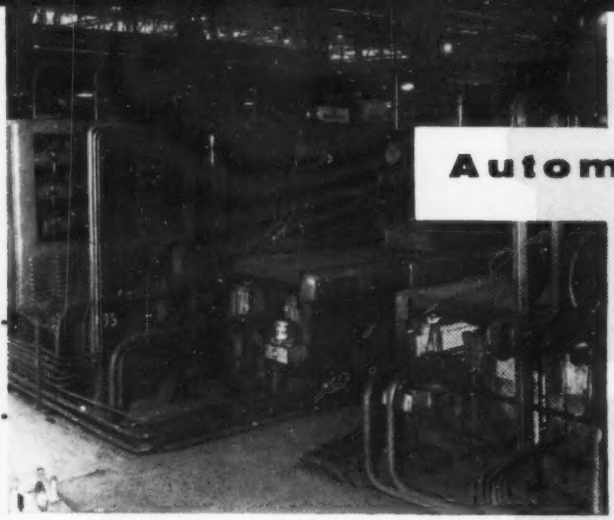

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none has devoted more thought and capital
to its exploitation:
none is more alive to the need
for the utmost reliability and flexibility
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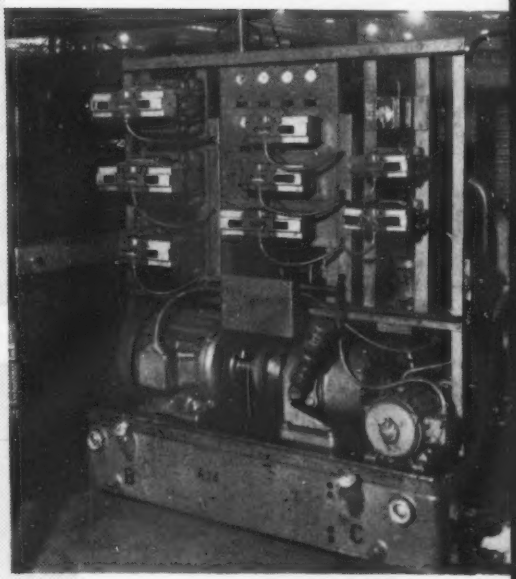
General view of the rear of the Alfing 11-Station Transfer Machines showing some of the VICKERS-DETROIT *Oil Hydraulics used on the cam and crankshaft boring lines for the 4 and 6 cylinder tractor blocks.*

On the right is the Alfing 11-Station Transfer Machine with covers removed to show one of the VICKERS-DETROIT *power units and control panel*



Ford Motor Company Limited uses
VICKERS-DETROIT Oil Hydraulic units
to control the
11-Station Transfer Machines
shown here. For further details
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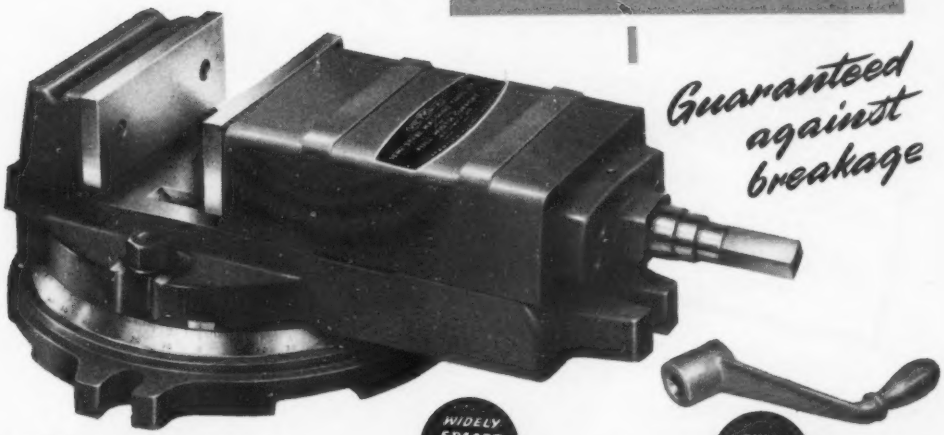

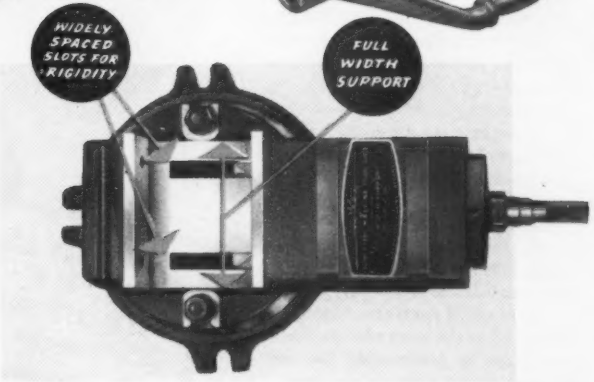

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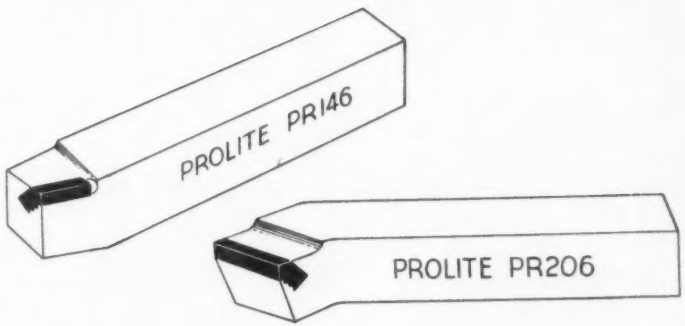

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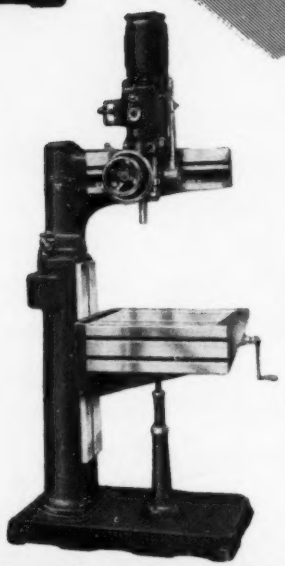

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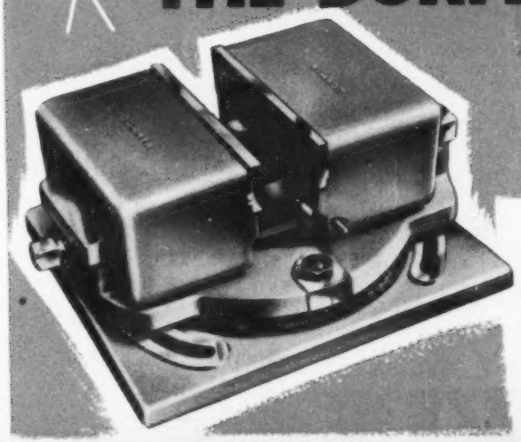

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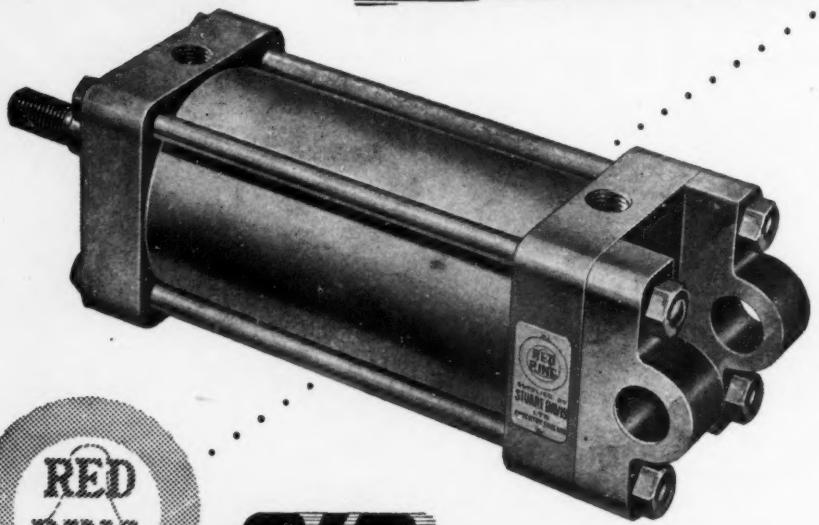

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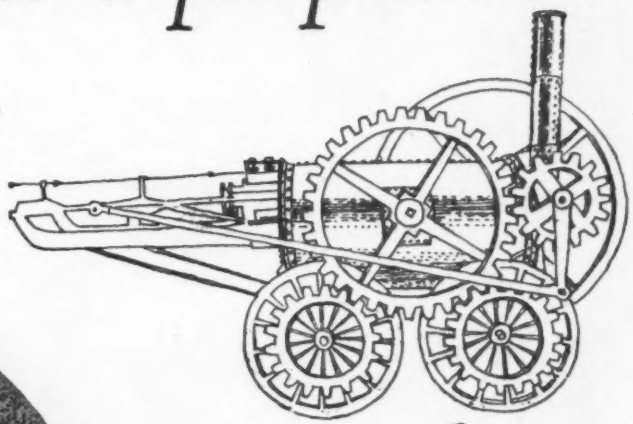

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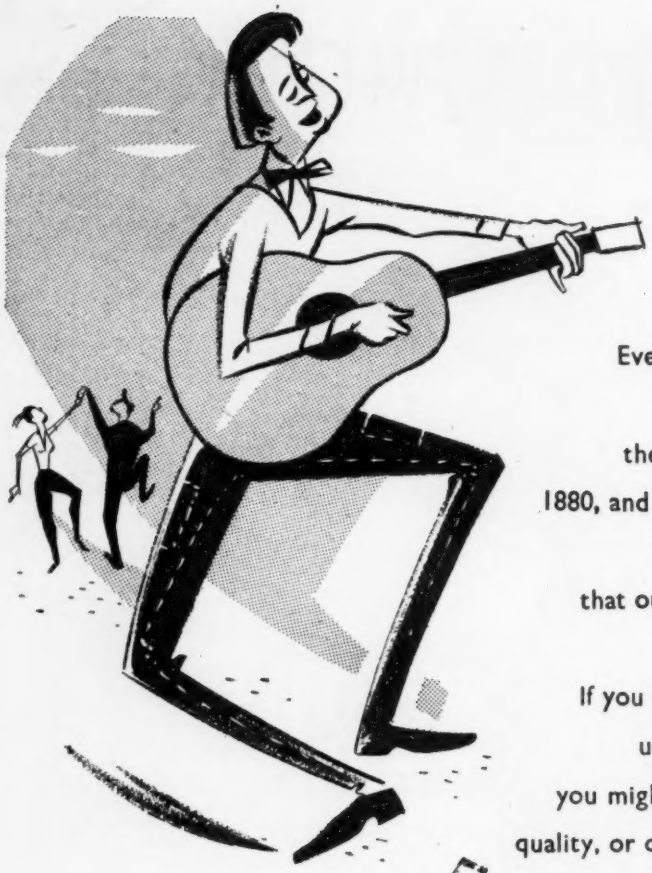

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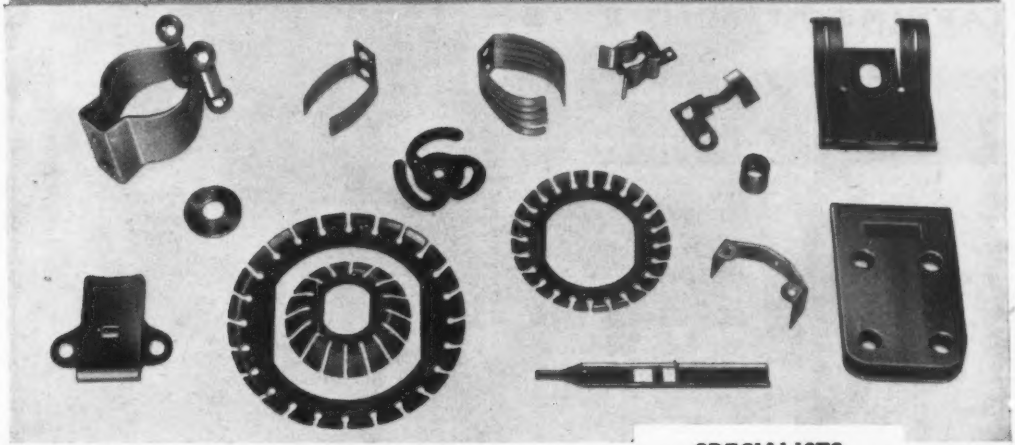

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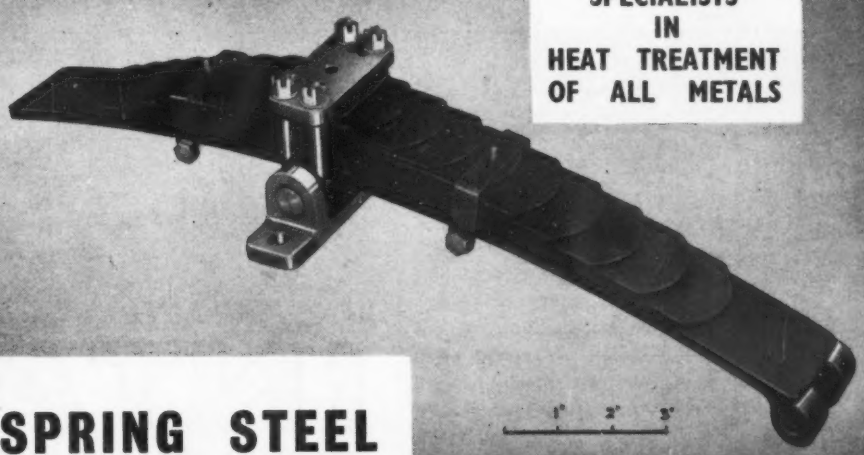

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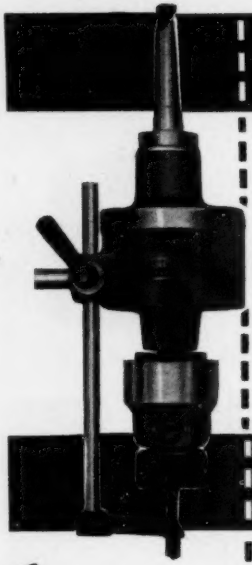

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Safety friction drive eliminates tap breakages

★ Ask for List No. 105

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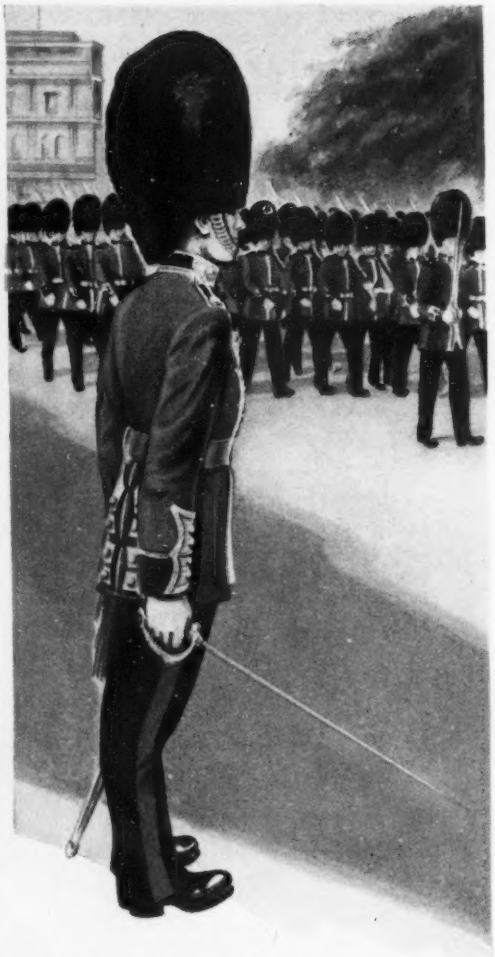

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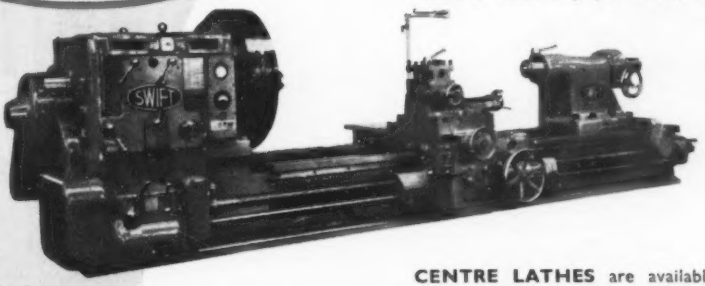
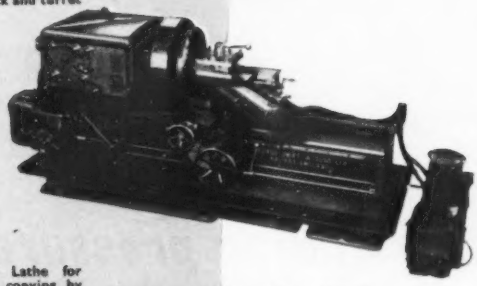


42in. swing Extra Heavy Duty Centre Lathe with 16ft. between centres.



12SV6 Lathe, 28in. swing, with 2ft. 6 in. between chuck and turret

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SURFACING & BORING LATHES cover a wide range of applications up to a maximum swing in gap of 99in. Larger sizes can be quoted for.

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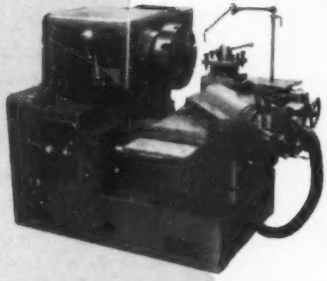
Write today for a catalogue describing the Swift range of lathes of the type which interests you.



'T' Lathe for face copying by hydraulic control. Maximum diameter admitted on this type 48in.

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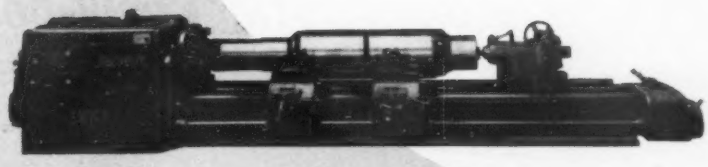

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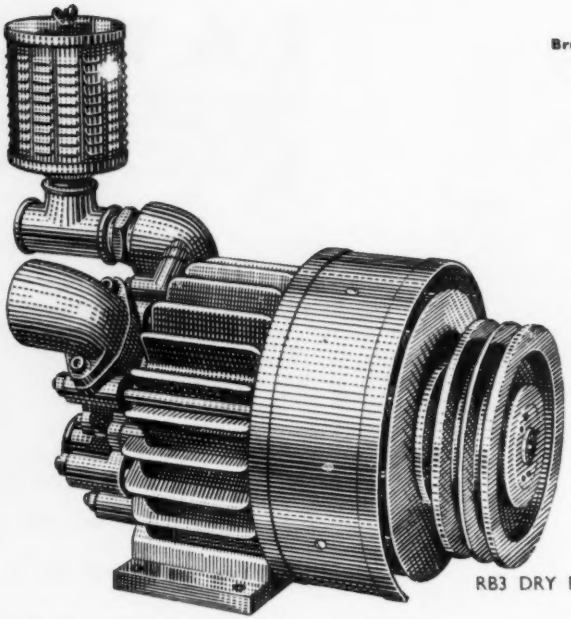

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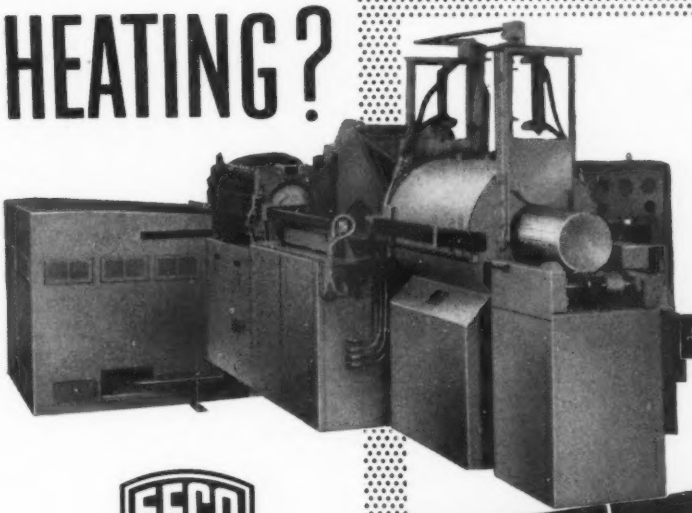

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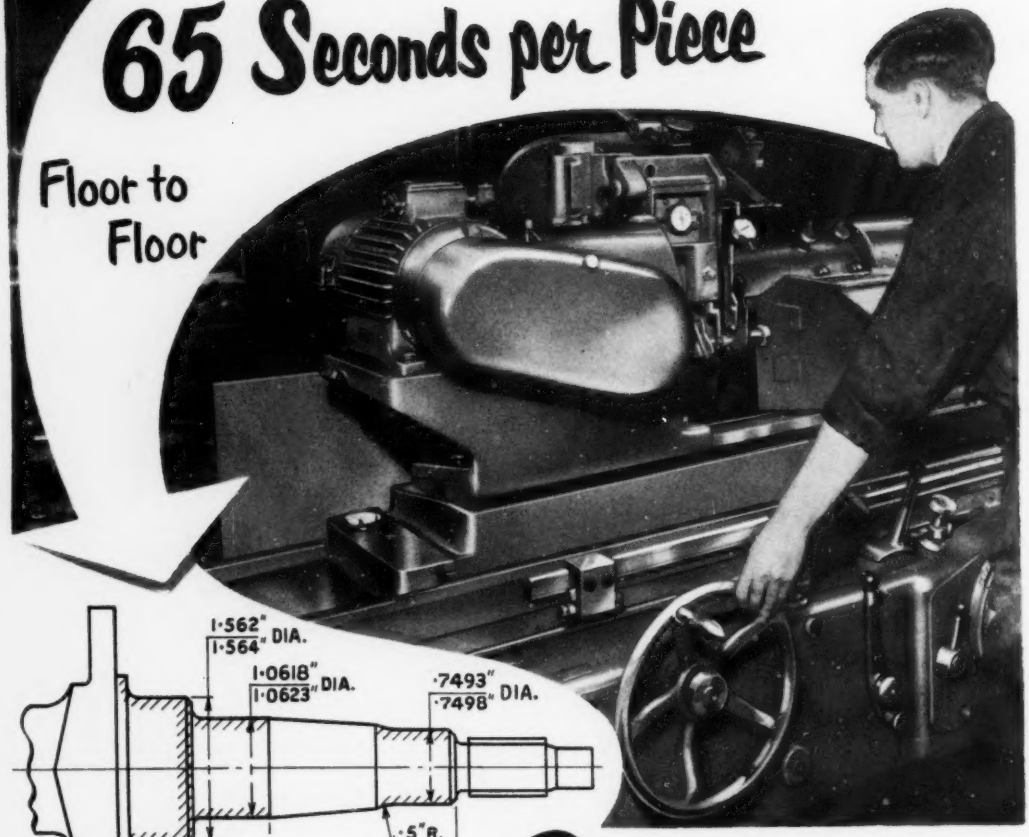

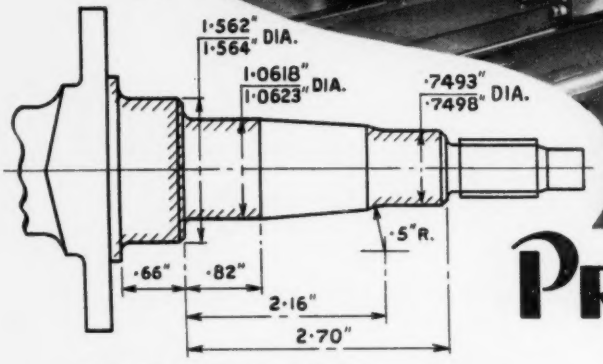

GROUND WHERE MARKED IIIII
PART VIEW OF COMPONENT

PRECIMAX Grinding

Stub Axles at Armstrong Patents Ltd.

The key to this outstanding production achievement is plunge grinding on the PRECIMAX model MPB 12/24. The stub axle shown in the drawing is of 80 ton tensile mild steel and amongst the many PRECIMAX features contributing to ultra high speed performance is the accurate dressing of the wheel allowing the simultaneous grinding of three diameters. PRECIMAX Grinding Machines are available in a wide range of types and sizes. *Our range includes precision fine boring machines as well as grinding machines. Send for full details.*

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JH 28

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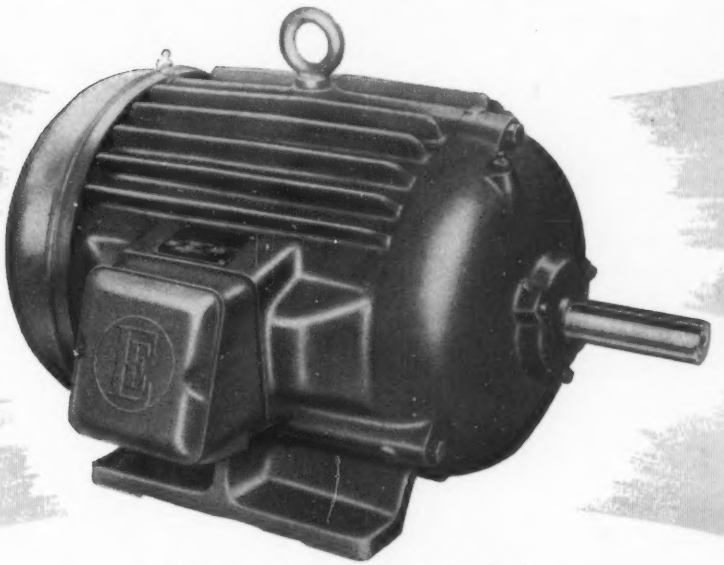
More price reductions

for 'ENGLISH ELECTRIC' motors



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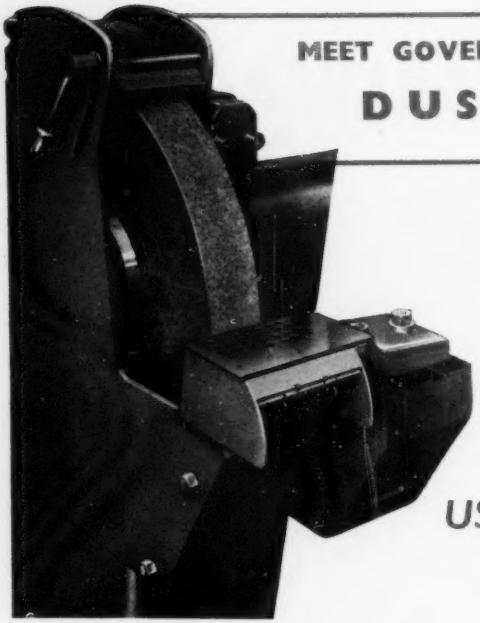

MEET GOVERNMENT REGULATIONS ON

DUST CONTROL

These machines embody the B.S.C.R.A. Patent System of Dust Control and comply with the new Government Regulation 1 of the Grinding of Metals (Misc. Indus.) Regulations, and Regulation 7, para. (6) of the Iron and Steel Foundries Regulations, 1953.

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HIGH SPEED

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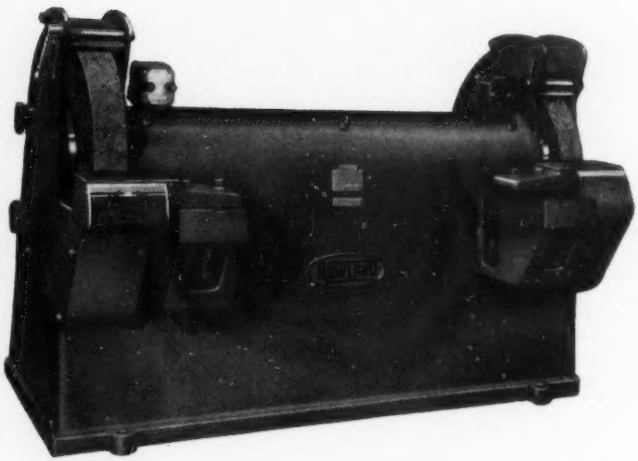
FLOOR GRINDERS

- ★ **Separate driving motors provide independent drive and control to each wheel.**
- ★ **Patent Compulsory Speed Change Device maintains maximum surface speed.**
- ★ **Efficient, foolproof Safety Devices provide adequate protection.**
- ★ **Wheels are collet mounted, not on spindle end, facilitating wheel change and reducing wear of spindle and nut.**
- ★ **Totally enclosed motors avoid electrical breakdown.**
- ★ **Short oversize spindles give maximum rigidity.**
- ★ **Precision pre-loaded A.C. and roller bearings, allied with sturdy all-steel construction give longest life and smoothest running, and maximum wheel performance.**

Built in three sizes with wheels 30in. dia. 24in. dia. and 18in. dia. respectively. Also available in the Single Wheel Type in all sizes. Details on request.



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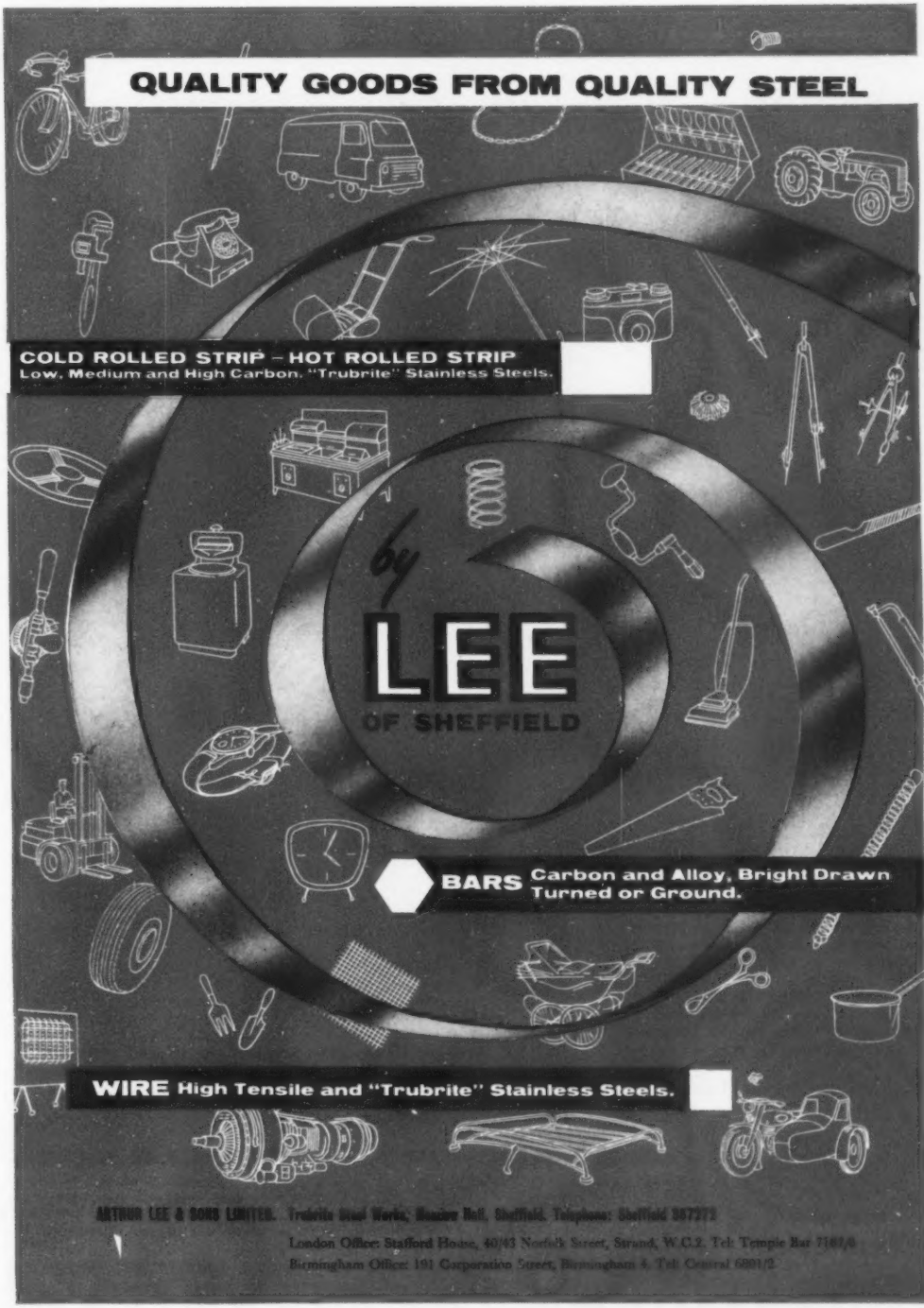
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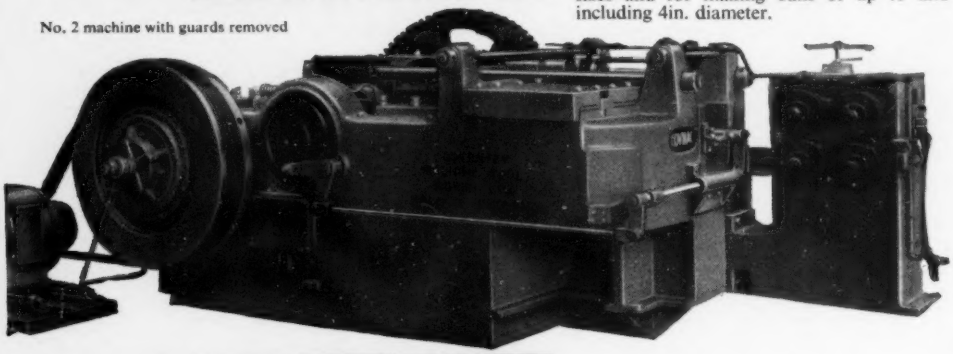
COVMAC AUTOMATIC FORGER

The stock is placed between the rolls and is then fed through the dies to the workstop. The die then closes, cutting off the stock to the required length and delivers it to the heading position. The heading tool then completes the forging, which falls down the chute on to conveyor. Supplied in several sizes and for making balls of up to and including 4in. diameter.

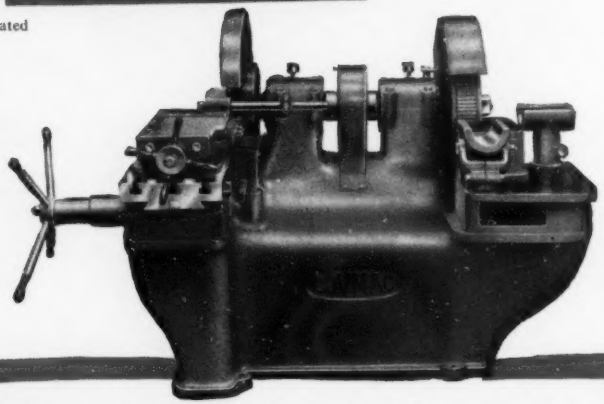
No. 2 machine with guards removed



COVMAC HOT MILLER

These machines are made in three sizes. The smallest handles bars up to 2in. diameter. The largest size, as illustrated, takes bars up to 4in. diameter. They are an invaluable asset to any forging or drop stamping plant.

No. 3 machine illustrated



We also make eight sizes of Standard Upsetting Machines to take bars from 1in. to 6in. diameter.

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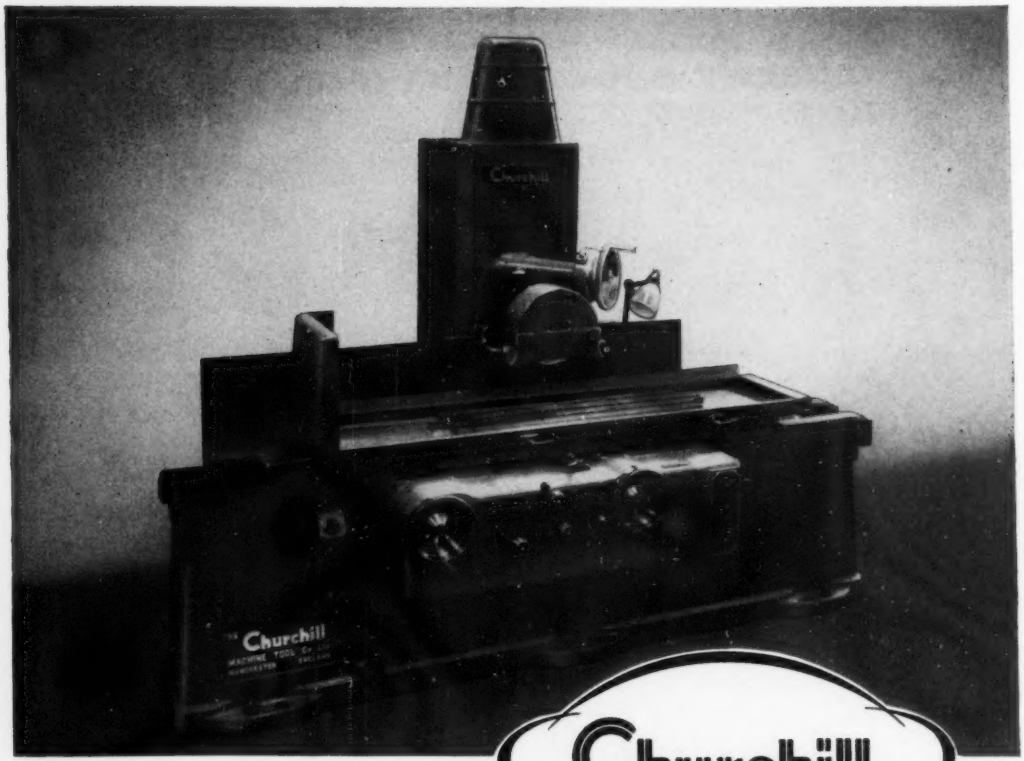

Churchill

'OSB'

HORIZONTAL SPINDLE SURFACE GRINDING MACHINE

This machine is designed for work requiring extremely accurate and highly finished flat surfaces. Besides being ideal for toolroom work and for die grinding, the Model 'OSB' can be used to advantage in the production line. High rates of output are obtainable. Built in three sizes with work tables 30in. by 10in., 42in. by 10in. and 60in. by 10in.

Easy and simple operation.
Built-in motor drive to grinding wheel spindle. Motorised automatic pump lubricating system and simple bearing assembly give a high precision spindle capable of heavy grinding cuts.
Variable hydraulic cross feed to wheel. Pre-set automatic cut-out and automatic reverse.
Fine and coarse vertical feed.
Massive cross slide underneath wheelhead column gives large area of support and maximum stability.
Hydraulic table traverse up to 90 feet per minute. Hand traverse interlocked with hydraulic control.
Permanently protected precision ground table slideways. Table traverse ways, wheelhead cross slideway and cross feed gears and bearings automatically lubricated from oil supply independent of hydraulic system.

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C662

For 3-dimensional tracer controlled reproduction

The tracer will follow the finest detail of any 3-dimensional model of any material, however soft or fragile, but *without actually touching it* and will duplicate to "tenths" precision.

There are many additional items of equipment for use with the "VELVE-TRACE" including DUPLEX ROTARY FIXTURE, RIGHT AND LEFT FIXTURES, ADJUSTABLE MODEL FIXTURE and DEPTH TEMPLATE ATTACHMENT.

We hope, if you are in any way interested, you will write to us for further details of this unique machine.

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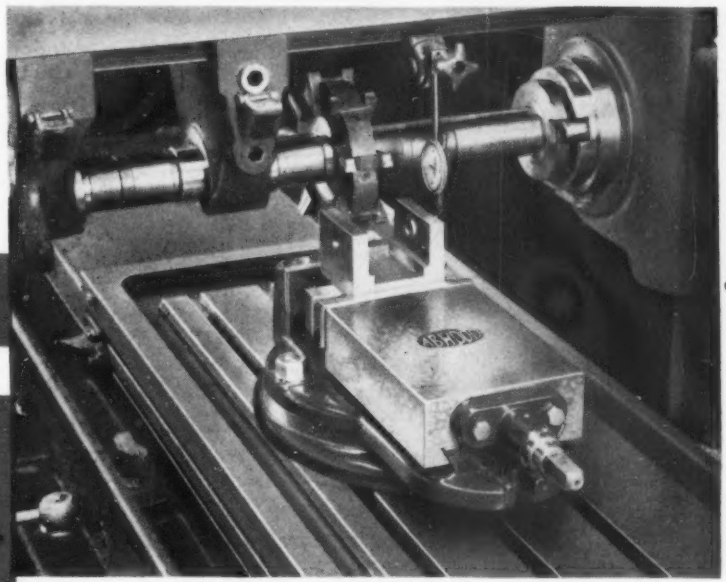
ABWOOD *For Accuracy plus Durability*

THE ABWOOD MODERN MACHINE VICE

NO TRAPS FOR SWARF
TOTAL ENCLOSURE OF SCREW & NUT

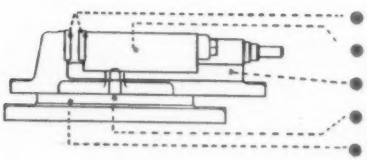
THE VICE WITH THE SLIDING JAW WHICH CANNOT LIFT AND TILT THE JOB



Clocking set-up of Drill Jig before milling faces for insertion of hardened location strips. This work-holding problem was resolved by the use of an Abwood Machine Vice thus ensuring complete absence of any lift.

FULL RANGE OF SIZES AND TYPES FROM 3" to 15"

VISUALISE WHAT AN IMMENSE SAVING THIS MEANS



- PRECISION GROUND CARBON STEEL JAWS
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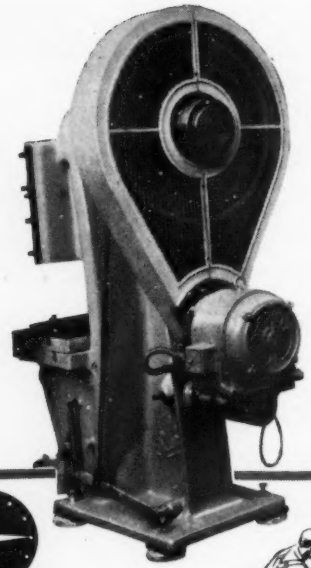
MV-1

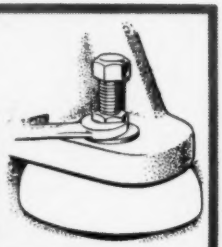
BREAKING INSTALLATION RECORDS WITHOUT BREAKING THE FLOOR



2.0 p.m. Problem. How to get this 50-ton press installed and working with the least possible production delay. How to hold it safe and levelled on an uneven floor riddled with pipe lines. Method chosen: "Barrymount" Levelling Machine Mounts, as specified by Cementation experts. Time taken: **two hours ten minutes.** This is how:—

3.15 p.m. Press in position. A "Barrymount" Machine Mount goes under each corner—bolted through the mounting hole. There's no grouting in: no rag bolting: no floorbreaking to be done at all.

3.45 p.m. Levelled. "Barrymount" Machine Mounts incorporate their own levelling device. The bolt is turned down and locked at precise levelling—exact to within a thou' even on sloping or rough floors. No inexact and time-wasting shimming.



4.10 p.m. Working. No long expensive production delays while the concrete dries out. Directly the press is connected to power, it's ready to work. Its "Barrymount" Machine Mounts act as highly efficient shock and vibration isolators; hold it firm and safe without a sign of 'walking'.

Where did all this happen?

We've taken a typical problem here; but it *could* happen in your machine shop. Cases like it crop up almost daily, all over the country, and they're all solved the same way. "Barrymount" Machine Mounts were introduced here from the U.S. some three years ago. Since then their use has spread to thousands of machine shops throughout Britain. Users report installation times cut from days to minutes; floor space better used; greater production flexibility and a dramatic decrease in structure-borne vibration and noise.

It's not uncommon for "Barrymount" machine mounts to pay for themselves at installation in terms of production time gained. It's pretty sure that a pilot set on the next machine you install—or move—could show you similar savings, too. If you'd like full technical details, get your secretary to fill in this coupon.

Modern machine tools belong on

MADE IN ENGLAND UNDER LICENCE
BARRY B MOUNT
FROM BARRY CONTROLS INC. OF U.S.A.

LEVELLING MACHINE MOUNTS

Made in steel and oil resistant neoprene to last the life of the machine. Suitable for lathes, grinders, presses, shapers of all makes up to 25 tons dead weight.

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Please send me full details of "Barrymount" Levelling Machine Mounts.

NAME .....

POSITION IN COMPANY .....

COMPANYS' NAME AND ADDRESS M7

3.4 Micro Inch Finish —AT PRODUCTION SPEED

HAGENUK

fully hydraulic SURFACE GRINDERS

TYPE H.G.I.

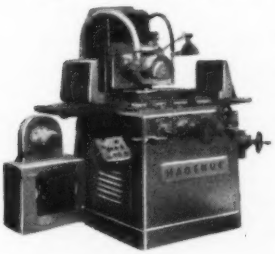
These machines give outstanding results, not only for productive capacity, but also for the high degree of surface finish obtainable without special preparation. On a sample taken at random and checked on a Talysurf, the finish was 3·4 micro inches.

NOTE THESE FEATURES

- Infinitely variable table speed 0 to 66ft. per minute.
- Infinitely variable cross feed 0 to $\frac{3}{8}$in.
- Automatic vertical feed.
- Foolproof hydraulic system giving absolutely shockless movement.

CAPACITY

Table Working Surface	7¼in. × 23½in.
Longitudinal movement	25in.
Cross movement	8in.
Vertical movement of head	12in.
Maximum distance table to wheel	13in.



TYPE H.G.2

This machine, too, has the same outstanding features and infinitely variable table longitudinal and cross movements as type H.G.I.

CAPACITY

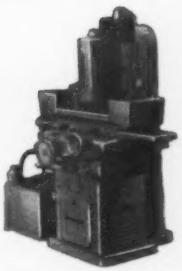
Table working surface	12in. × 24in.
Longitudinal movement ...	27½in.
Cross movement	13in.
Vertical movement of head ...	14in.

TYPE V.G.I

This machine has the same outstanding features and table longitudinal and cross movements as type H.G.I, but with vertical spindle.

CAPACITY

Table working surface	7½in. × 23½in.
Longitudinal movement ...	25in.
Cross movement	8in.
Vertical movement of head	11$\frac{13}{16}$in.



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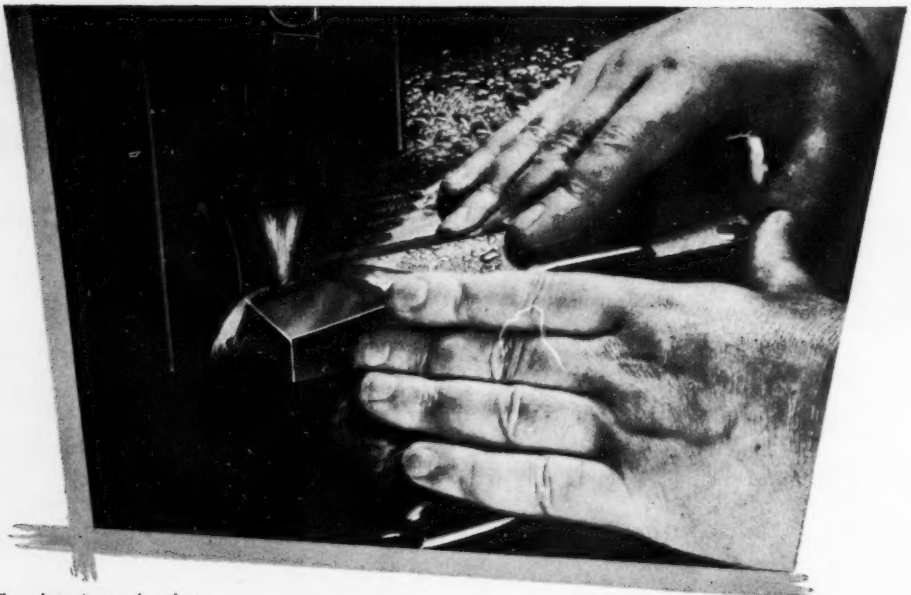

The photomicrographs show about ten thousandths of an inch of cutting edge, illustrating the difference in finish produced by grinding and lapping.

This photomicrograph shows irregularities in the cutting edge which are left after grinding on a Silicon Carbide Wheel.

After lapping on a diamond wheel, the tool possesses a fine strong cutting edge, which will yield a tool life three to four times longer, with infinitely higher finish on the work and greater accuracy.

How to get longer life from carbide tools—

The difference in appearance between a diamond lapped tool and one dressed on a grit wheel is probably imperceptible to the naked eye. But in fact, there is a profound difference as these photomicrographs show.

The cutting-edge produced by a silicon carbide wheel consists of minute irregularities which quickly break down under cutting pressures and lead to early tool failure. Compare this with the fine even cutting edge produced by diamond-lapping and it is easily understood why diamond lapped tools yield a life frequently over three times as long.

Diamond lapping pays for itself in terms of machine down time alone, and provides the additional benefits of improved finish, and maintained accuracy as a bonus.

For OFF-HAND grinding always specify

NEVEN METALLIC BONDED DIAMOND WHEELS

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MACHINERY

A JOURNAL OF METAL-WORKING PRACTICE AND MACHINE TOOLS

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Abstracts of Principal Articles

Aspects of Russian Engineering Industry P. 4

The expansion of Russian medium and light engineering industries during the past 15 years has been an economic development of major importance. This expansion has been made possible, principally, by the planned growth of the heavy industries and power supply facilities during the pre-war years, and has necessitated a parallel expansion of machine-tool building. In 1956, the number of machine tools produced by Soviet plants was more than double the output of 1940. Modern Soviet machine tools are of a high standard, and some typical recent designs are described and illustrated, including a milling machine with 3-dimensional copying facilities and programme control, a broaching machine arranged for automatic work-loading and unloading, a spiral bevel gear generator with mechanized work-handling equipment, and a grinder for internal gear teeth. (MACHINERY, 93—2/7/58.)

Operations on the Jameson Universal Production Aerofoil Generating Machine P. 11

A previous article in MACHINERY (92/876—18/4/58) described the design and principle of operation of the Jameson aerofoil generating machine, and in this article details are given of the milling head attachment which can be fitted to the front of the tool-slide. Recent design improvements to the manner in which the knife-edges are applied to the templates are discussed, including the addition of a tracer-valve which eliminates the need for relieving the followers from the templates after each span-wise cut has been taken. The machining methods adopted for various designs of wing panel are outlined, and the method of positioning the work-piece on the table is described. (MACHINERY, 93—2/7/58.)

Production of Titanium Rings from Extruded Sections ..... P. 16

To obtain improved utilization of titanium, new techniques have been developed for producing ring type components. Reference was made to these methods in a paper presented to the American Society of Automotive Engineers, and it was explained that the procedure involves extruding sections with a minimum machining envelope, contour forming and flash-butt welding, sizing, and finish machining. Extrusion is first discussed and it is stated that substantial additional economies can be obtained by processing cast ingots without preliminary forging. Investigations have shown that extrusions produced from such ingots possess satisfactory properties. Other parts of the paper were devoted to contour forming, which is carried out with both the tools and material heated; flash butt welding; and sizing. Finally, the economics of the process are considered, and it is stated that cost reductions of the order of 25 per cent are normally obtained, apart from savings at the machining stage. (MACHINERY, 93—2/7/58.)

Practical Examples of the Application of Ceroc Sintered Ceramic Cutting Tools P. 20

Ceroc ceramic tools, produced by Compagnie Générale d'Electro-Ceramique are now being successfully employed in a number of French factories, and details of some of the results that have been achieved are given here. In many instances, the machines employed are at least eight years old, and interrupted cutting has been undertaken satisfactorily. The operations for which Ceroc tools have been used include turning, boring and shaping, and the materials machined range from cast iron to alloy die steel. (MACHINERY, 93—2/7/58.)

Rotary Table with Optical Coincidence System..... P. 22

Intended for use on jig boring machines and other equipment where very accurate circular spacing or angular positioning is required, the table here described incorporates a Gurley Unisec optical coincidence system, which is claimed to give a reading to 1 sec. of arc, with an overall accuracy of 3 sec. This system is characterized by the fact that simultaneous readings are obtained on both sides of a graduated circle so that any errors due to eccentricity are cancelled. A diagram of the arrangement is included, also a close up view showing a typical reading, as observed by the operator. (MACHINERY, 93—2/7/58.)

Factors Affecting Performance in Cylindrical Grinding..... P. 24

In this article it is pointed out that the performance of an abrasive wheel varies considerably, depending on the speeds and feeds at which it is operated. For cylindrical grinding, the basic operating factors are: traverse speed, work surface speed, width of cut, amount of in-feed, and the distance that the wheel is permitted to run off the work at the end of each path. The considerations which determine the most suitable speed and feed are examined, and attention is then drawn to the importance of adequate spindle power for economical grinding. In conclusion, reference is made to the effects of machine condition, and to grinding fluids. (MACHINERY, 93—2/7/58.)

An Automatic Austempering Plant.....P. 43

Type bars for electric typewriters made by International Business Machines Corp. are austempered completely automatically in a special plant supplied by the Selas Corporation of America. The type bars, of AISI 1040 steel, are loaded on fixtures projecting from the periphery of a wheel-type conveyor, whereby they are carried through a high temperature furnace and heated to 1,550 deg. F. in 25 sec. When the bars are released from the fixtures, they fall down a chute into a salt bath which is held at a temperature of 680 deg. F. In this bath the bars are retained for a minimum of 15 min., while the austenitic structure is changed to bainite with a hardness of Rockwell 42-44 C. (MACHINERY, 93—2/7/58.)

Economical Machining Methods for Large Parts

Many components of small and medium size, when required in sufficient quantities, can be very economically machined with equipment of the automatic work-transfer type. Depending on individual requirements, machines for this purpose may be of in-line, rotary, or rectangular forms, and in some industries the use of such machines is already well established. Because of the efficiency attainable, moreover, the field of application for transfer machines is likely to be rapidly extended in the future.

Parts processed on transfer machines are normally of such dimensions that they can readily be moved from station to station, for a series of operations, and if necessary fixtures may be provided to facilitate holding and location. With heavy workpieces of very large dimensions, however, it is obviously desirable that handling during machining should be kept to a minimum and that as much work as possible should be carried out at each setting. There have been some important developments in this field during recent years, and attention may be drawn, for example, to the use of large floor plates on which several parts may be set up at one time. Long beds for travelling-column horizontal boring machines are provided adjacent to such plates, and other machines, including radial drills, may be lifted bodily and installed on the plate in various positions, as required. The versatility of a floor-plate arrangement of this type is considerably enhanced where the nature of the work permits the use of a large rotary indexing table, whereby various faces can be presented for machining without disturbing the setting.

Another approach to the problem of expediting operations on large and heavy parts is the provision of supplementary facilities on machines of certain basic types. A heavy-duty plano-milling machine, for instance, has been equipped with a drilling and boring head at the rear of the cross rail to extend the range of work that can be undertaken. Similarly, provision may be made on large planing machines for cross- and deep end-cutting, also for grinding operations.

Although such arrangements have proved very effective, they are unsuitable for some classes of workpieces, which, although they cannot properly be regarded as coming within the field of heavy engineering, exceed the dimensions normally associated with transfer machines. There is, of course, no particular size limit for transfer machines provided that parts are required in sufficient numbers, and such equipment has been built for handling quite large pieces. Where a considerable number of stations is necessary, however, the overall dimensions of a transfer machine for heavy work may soon become impractically large.

To provide some of the facilities of transfer machining, in conjunction with increased adaptability and considerable savings both in space and capital cost, an interesting system has been developed by a manufacturer of road-making equipment in the U.S.A. and a leading machine-tool builder. The basic principle of this system is that the work is held in a fixture which is arranged for horizontal shuttle movement on a base and the tool heads are carried on an adjacent, rotary indexing table at the end of the work-slide bed. All feed movements, except for such operations as tapping and facing, are applied to the saddle on which the work fixture is mounted, and provision can be made for fitting fixtures to suit different workpieces. It will be evident that with such an arrangement, only one tool head is in operation at a time, and the machine is so designed that only the head in the operating position is driven. A particular machine of this type has a rotary table with six tool heads, and is employed for operations on three welded steel casings and the corresponding cover plates. For this range of workpieces, three fixtures are required, and only three of the tool heads are needed for any one component. Only two hydraulic units are employed in this installation, one for the shuttle movement of the work fixture, and the other for indexing the table, which has a diameter of 8 ft., and weighs, with full equipment, about 40 tons.

More elaborate arrangements can also be provided, and another installation comprises two rotary tables, each with five heads, and a base for a fixture slide between them. It is thus possible to perform series of operations on opposite sides of the work at one loading. Conversely, two shuttle type work holding fixtures may be employed in conjunction with a single rotary table carrying tool heads, the fixture beds being disposed either opposite to one another or at an angle, depending upon whether the number of heads is

(*Continued on page* 51)

Aspects of Russian Engineering Industry

Some Impressions Based on a First-hand Study of Soviet Plants

The rapid expansion of the engineering industries of the U.S.S.R. has been one of the most important and far-reaching developments in the economic field during the past 15 years. Before the revolution, engineering activity in Russia was on a small scale, and many of the plants that were then in existence were subsidiaries of, or were closely associated with, foreign manufacturing organizations. Successive Five Year Plans, which were initiated during the years that preceded the second world war, laid the foundations for a vast industrial expansion, by concentrating effort on the development of the heavy industries, the establishment of large-scale supply facilities for electrical power, and the exploitation of Russia's extensive mineral and other natural resources. This work has been continued since the end of the second world war, partly to further expand existing plants and facilities, and to establish new factories and power stations in the remoter areas of the Soviet Union, also to make good the heavy damage that some of the older factories sustained during the war years. At the same time, increasing attention has been paid to the expansion of the medium and light branches of engineering, and, in consequence, by the end of 1956, industrial output generally had been increased more than 30 times, and production in the heavy industries more than 50 times, in comparison with the pre-revolution period. More recently, efforts have been made to expand the production of consumer goods, and these products—including refrigerators, washing machines, vacuum cleaners and sewing machines, for example—are becoming available in increasing quantities.

This article is the first of a series which is based on a first-hand study of certain branches of Soviet industry. In this series, developments in these branches will be discussed, and equipment and production methods will be described which are considered to be of interest to readers of MACHINERY.

EXPANSION OF THE SOVIET MACHINE TOOL INDUSTRY

Post-war industrial expansion has resulted in an ever-growing demand for new metal-working equipment. Before the war, much of this equipment was imported into the Soviet Union, but, since the war, supplies from many pre-war sources have been cut off or seriously restricted, for various reasons. Although it has been possible to obtain many machine tools from East Germany, Czecho-Slovakia and other countries in the Communist *bloc*, the numbers obtained from these sources have fallen far below Russian requirements, and it has been necessary substantially to build up the facilities for the production of machine-tools and associated equipment within the Soviet Union.

An indication of the effort that has been made, and the results that have been achieved, is afforded by the chart, Fig. 1. Each column of this chart represents the total number of different types and sizes of machine-tools made in the U.S.S.R. during the specified years. It should be pointed out that machines of one type (for instance, milling machines or lathes) but of different sizes are considered as separate units, whereas if machines of the same size and type (for example, plain grinding machines with maximum capacity for work of 200 mm. diameter by 1,500 mm. long) are made by several different plants, all such machines are grouped together and classed as one type. Moreover, it should be noted that although the other figures are based on actual results, the planned total number of types is given for 1960.

Further evidence of the expansion of the Russian machine-tool industry is afforded by the following statistics. In the year 1913, the total number of metal-cutting machine tools of all types that was produced was 1,500. By 1940, output had risen to 58,400 units per year. There was a serious decline during the second world war, when many plants were evacuated or were engaged on munitions production, but in 1956, the total output of machine tools for the year was 121,300, and by 1960 it is planned that the annual output will have reached 200,000 machines. With regard to the output of different types of machines, it may be of interest to consider the statistics for centre lathes, automatic and semi-automatic lathes, cylindrical grinding machines, and gear-cutting machines. In 1913, four different types of centre lathes were built in Russia and the total output for that year was 700 machines. By the end of 1940, 59 different types of centre lathes were being built in Soviet plants, and the annual output had risen to 11,500 units. For 1955, the corresponding figures for lathe types and output were

159 and 31,300, and it is planned that during 1960 the number of different types of lathes will have risen to 240 and the annual output to 50,000.

Exactly comparable figures are not available for automatic and semi-automatic lathes, but in 1937, 22 different machines in this category were being built in the U.S.S.R., and the total output for that year was 894 units. The number of different types had been increased to 49 by the end of 1956, and during that year 1,625 automatic and semi-automatic lathes were built. By the end of 1960, it is planned to increase the number of different types of these machines to 69, and to expand output to 4,536.

In 1940, nine different types of cylindrical grinding machines were being built in Soviet plants, and the total output of these machines during that year was 592 units. By the end of 1956, the number of different types had grown to 16, and the annual output was 1,836 units, and the planned production for 1960 is 5,610 machines of 43 different types. The statistics for gear cutting equipment show that in 1940, there were 15 different types of Soviet-built machines, and the total output for that year was 540. During 1956, 82 different types of gear-cutting machines were built, and the total ouput for the year was 2,140 units. By 1960, it is planned to build machines of 135 different types, and the estimated output for that year is 4,500 units.

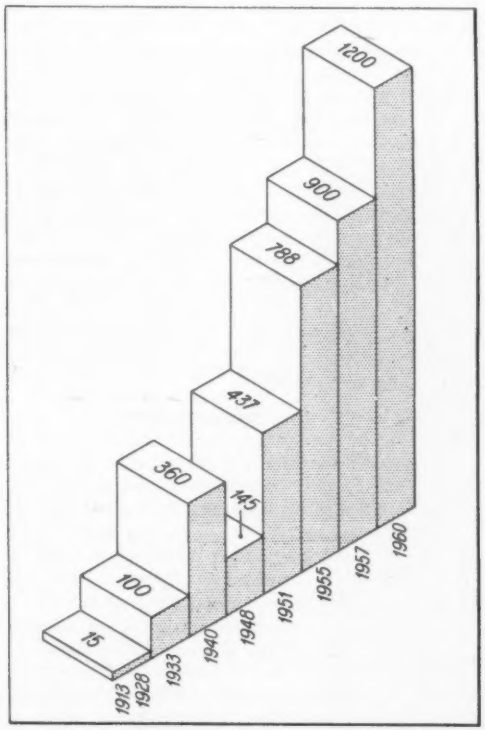


Fig. 1. The Growth of the Soviet Machine-tool Industry is Indicated by this Chart, which Shows the Number of Different Types of Machines Built in Certain Years. Where Machines of Similar Type and Size are Built by Several Plants, they are Classed as One Type

NEW RUSSIAN MACHINE-TOOLS

From time to time, reference has been made in MACHINERY to new Russian machine tools, particularly in connection with the Leipzig Fair, and some of the latest types were shown and briefly described in 92/1475—20/6/58. These machines are of modern design and of good finish, and, as far as can be ascertained from a visual inspection, are of a high standard of quality. The conclusion with regard to quality is confirmed by the Russian-built machines already installed in Soviet plants, which, although somewhat older, are producing an extensive variety of precision components in large quantities, six days per week, and reference to these machines and the production set-ups employed will be made later in this series. In many instances, the designs of machines have been based on earlier units that were imported from such sources as the U.S.A. or Great Britain, but close liaison is maintained between the design departments of various machine-tool plants and the potential users, and the Soviet-built machines incorporate many detail improvements that have been found desirable in the light of operational experience.

In addition, machine-tool plants are served by various efficiently-equipped and well-staffed research institutes, where new control and cutting techniques are developed, and basic research concerned with the design of machines and cutting tools is undertaken. These research institutes, moreover, usually have extensive workshops where new equipment may be tried out under normal operating conditions, and where pilot batches of new machines may be built, once the design has been finalized and the prototype approved, before production is turned over to an orthodox machine-tool plant.

Before describing some of the Soviet machine-tool plants and research institutes, it may be of interest to consider briefly a few of the latest types of Russian-built machines. These machines are to be installed in a pavilion of the permanent Indus-

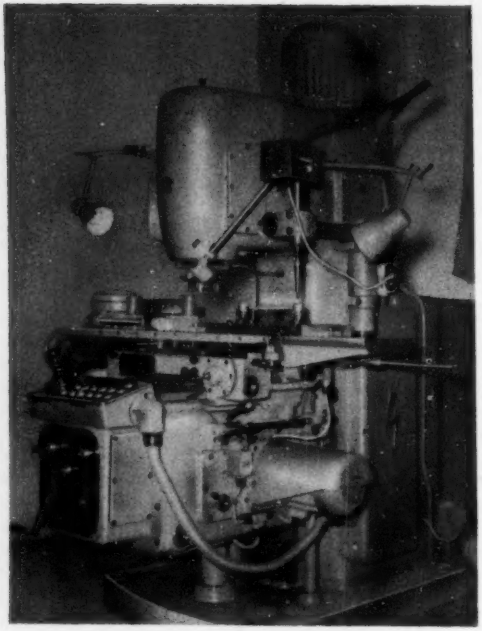


Fig. 2. This Dmitrovski Vertical Milling Machine is Fitted with an Electrical Copying System, and can be Operated under Programme Control from a Punched Paper Tape

trial Exhibition, on the outskirts of Moscow, which occupies more than 500 acres. There are 21 pavilions, which house more than 40,000 exhibits, and in addition to the machine-tool section, there are pavilions devoted to atomic energy, electrical engineering, instrument making, metrology, the iron and steel industry, and the motor-car industry.

In Fig. 2 is shown a vertical milling machine built by the Dmitrovski plant, which has a work-table measuring approximately 45 by 10 in. The cutter spindle is driven by a 6-h.p. motor, and there is a separate feed motor, flange mounted on the right-hand side of the knee. Copy-milling operations can be carried out under programme control, the movements for the desired programme being derived from a punched paper tape. This tape is carried on drums in a sensing unit, which is housed in a glass-fronted box on the left-hand side of the column. Hand-adjustment of the table, knee and saddle can be carried out from the operating position at the front of the machine, and for this purpose there are three stub-shafts projecting from the knee, to which a folding-type crank handle can be fitted. At the operating position, there is also a control panel with push-buttons for engaging the various power-operated motions and the cutter-spindle drive, as well as an over-riding joy-stick control. The follower unit for the electrical copying system is mounted on a swinging arm at the right-hand side of the column, and can be adjusted vertically and horizontally. An extension piece is fitted to the end of the main work-table to carry copying masters and templates.

The machine is shown set-up for milling the faces of three bosses on a workpiece by a combination of programme control and copy-milling. An air-operated fixture is mounted at the left-hand end of the machine table, and the work is clamped by swinging fingers, which are operated by a short-stroke, diaphragm-type pneumatic cylinder. At the opposite end of the table there is a sub-base, with transverse T-slots, whereon are mounted three pillars. The positions of the pillars correspond to the locations of the bosses that are to be milled on the workpiece, and their upper faces are arranged to be in the same height-relationship as the machined surfaces of the bosses. Under tape control, the table is moved in the horizontal plane, so that the stylus of the follower unit engages each pillar in turn. As it makes contact with each pillar, the horizontal motion ceases, and the knee is lowered until the stylus can pass across the upper face of the pillar, thus setting the workpiece at the correct height relative to the cutter. Horizontal motion is then resumed at the correct cutting feed rate, and when the stylus moves clear of each pillar (that is, when each boss has been machined) the table is moved, at the rapid-traverse rate, to the next machining position.

AUTOMATIC BROACHING MACHINE

Two new broaching machines are shown in Fig. 3. The machine in the background is set-up for surface broaching, and has been built by the Minsk Machine Tool Plant. It has a capacity of approximately 10 tons, and is equipped with a simple chute-type magazine for the workpieces, which are loaded and clamped hydraulically.

The machine seen in the foreground has a capacity of 20 tons, and has been built by Moscow Experimental Scientific Research Institute for Metal-cutting Machine-tools (ENIMS). Like the Minsk machine, it is hydraulically powered, and has been arranged for broaching internal splines in gear blanks, on an automatic cycle. Blanks are loaded on to one of three vertical pillars at the right-hand side of the machine. The pillars project upwards from a circular platform, and there is a similar unit at the left-hand side of the machine

to receive the broached workpieces. Normally, blanks are loaded on to a pillar in the position at the extreme right in Fig. 2, and the platform is indexed automatically in increments of 120 deg., to bring each stack of workpieces, in turn, to the position adjacent to the base of the machine. In this position, the stack is in line with the transfer ways mounted crosswise on top of the base, and the lowermost blank in the stack is engaged by an elevator unit, which slides on two vertical circular guide members. This unit is connected to a loop of roller chain, and there is a similar chain-driven elevator unit at the other side of the machine. The two chain loops are connected by a cross-shaft and sprockets at the bottom of the machine base, and both are operated by a hydraulically-powered mechanism, so that as one elevator rises the other unit descends.

Controlled by trips and limit switches, the elevator unit for the unbroached blanks is raised intermittently, in phase with the movement of the machine ram. In consequence, one blank at a time is aligned with the transfer ways, and is lifted clear of the supporting pillar. This blank is then moved sideways by semi-circular fingers on a hydraulically - operated shuttle, mounted above the transfer ways, and during successive machine cycles, the blank is moved along the ways to the broaching position. Here, the internal splines are cut, and the broached workpiece is moved sideways as further blanks are advanced, until it reaches the end of the transfer ways. During the next cycle of the machine, the broached workpiece is transferred on to the stack of pieces at the left-hand side of the machine, and this stack is lowered before the next workpiece is delivered. When the stack of broached workpieces is complete, all the blanks have been removed from the pillar at the right-hand side of the machine. Then, both sets of pillars are indexed to bring a fresh stack of blanks into the transfer position at the right, and an unloaded pillar into position at the left. During this motion, the right-hand elevator unit is lowered, and the left-hand unit is raised.

AUTOMATIC LOADING ON SPIRAL BEVEL GEAR GENERATOR

A number of machines for cutting and finishing spiral bevel gears has been developed by ENIMS, and a large pinion generator is exhibited, arranged for automatic loading and unloading of the workpieces. The machine will cut teeth up to 10 module, and the maximum diameter of workpiece that can be accommodated is 500 mm. (19⅝ in.). Gears with cone angles from 5 deg. 30 min. to 48 deg. may be cut, and the maximum speed of the multi-tooth cutter is 300 ft. per min. The machine is being exhibited set up for cutting teeth on rear-axle components for the Moscovitch small car, in a cycle time of 8 sec.

A close-up view of the loading arrangements is given in Fig. 4. Turned blanks are loaded into the upper chute *A* and roll downwards towards the working position. At the lower end of the chute there are two plungers, and the lower end of one

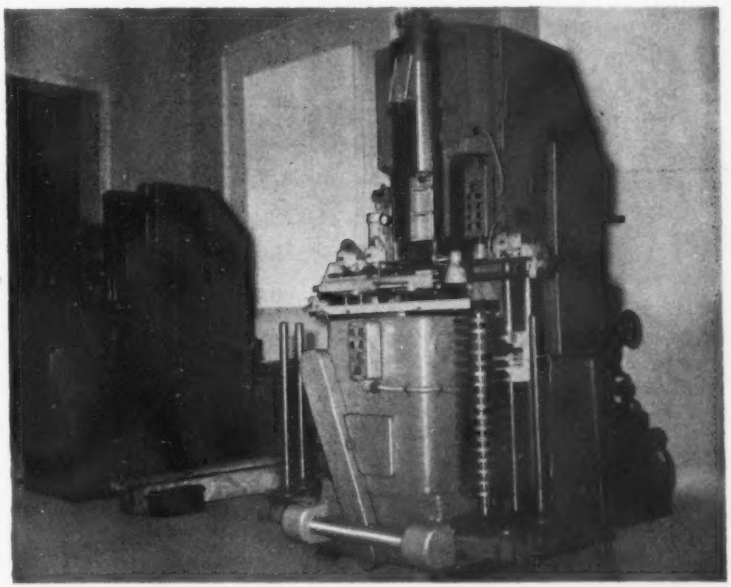


Fig. 3. Two Russian Vertical Broaching Machines. A Minsk Machine Arranged for Surface Broaching, with Magazine Feed for the Workpieces, is Seen in the Background. The ENIMS Machine in the Foreground is Equipped for Broaching the Splines in Gear Blanks, which are Automatically Loaded and Unloaded

plunger may be seen at *B*. There is a cross-pin in the lower end of each plunger which is engaged by the bifurcated forked-end of a double lever, whereby the plungers can be raised and lowered. The arrangement is such that as one plunger is lowered the other is raised, and in this way one blank at a time is released and allowed to advance to the inner end of the upper chute.

Adjacent to the inner end of the chute there is a horizontal slide, which can be moved in guideways at 90 deg. to the chute. This slide has two pairs of hydraulically-operated jaws, the upper

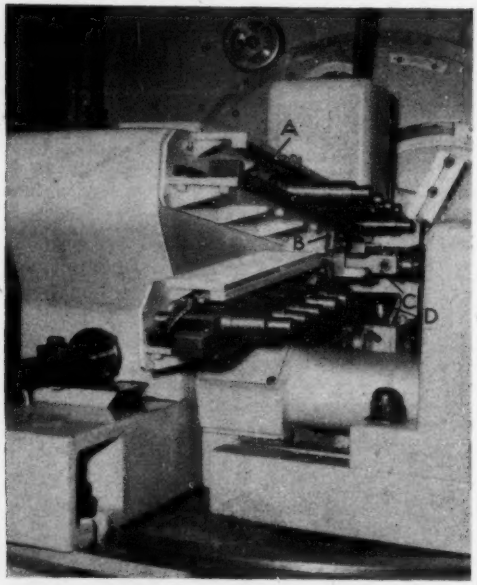


Fig. 4. Close-up View of the Magazine Loading and Unloading Arrangements on a Spiral Bevel Gear Generator Built by the Machine Tool Research Institute ENIMS. The Machine is Set-up for Cutting Teeth on Rear-axle Components of the Moscovitch Light Car

pair being in line with the in-feed chute, and the lower pair in line with the work-holding collet chuck of the machine. At the end of the cutting stage of the machine cycle, the slide is advanced, and the upper jaws grip the innermost blank in the in-feed chute, while the lower jaws grip the workpiece, in the collet, on which the teeth have been cut. Then, the slide is withdrawn, extracting the workpiece from the collet and the blank from the chute, and one of the lower jaws is indicated at *C* in Fig. 4 in engagement with a workpiece which is partially withdrawn from the chuck. At the end of the withdrawal movement, the slide-carrying member is lowered, to transfer the workpiece to an intermediate platform at the inner end of the lower chute, this platform being indicated at *D*. At the same time, the blank in the upper jaws is aligned with the empty collet. Next, the workpiece in the lower jaws is released, and rolls down the intermediate platform, to a position below the end of the outlet chute, and it is lifted from this position by an auxiliary ram during the next cycle, so that it passes into the chute. Once the workpiece is clear of the lower jaws, the slide is advanced, and the blank in the upper jaws is loaded into the collet, which is then closed. Finally, the slide is withdrawn and raised in readiness for the next loading sequence, and the cutting cycle is initiated.

GRINDING MACHINES FOR GEARS

Fig. 5 shows a machine for grinding the teeth of spiral-type bevel gears, which has been developed by ENIMS. This machine is shown set-up for grinding teeth of 8 module, on a gear of 180 mm. (7·086 in.) maximum diameter, but it will accommodate gears with maximum diameters up to 800 mm. (31½ in.), with teeth of 20 module. The number of teeth can vary from 4 to 160, and they are ground with a cup wheel, which can be run at any one of five speeds from 1,130 to 4,150 r.p.m. A corrected involute form is produced on the front of the grinding wheel by three dressing units. All of these units are hydraulically operated, and dressing is carried out on an automatic cycle, using diamond tools. The front face of the wheel is dressed by a tool at the left-hand side of the head, and the two tools on the right-hand side produce the involute surfaces on the inside and outside of the wheel rim.

A new machine for grinding the teeth of internal gears is shown in Fig. 6. This machine is built by the Moscow Grinding Machine Plant (MCZ) and the maximum diameter of the internal gear teeth that can be ground is 600 mm. (23⅝ in.). The largest size of tooth that can be ground is 10 module, and the maximum face width is 100 mm. (3$\frac{15}{16}$ in.). A gear to be ground is mounted in the chuck of the work-head, seen at the left, and this unit incorporates a dividing wormwheel of large diameter, in order to reduce indexing errors. The grinding wheel is carried on the end of a horizontal ram that projects from the wheel-head at the right. This latter unit slides on a vertical column, and the complete column and wheel-head assembly is reciprocated on guideways integral

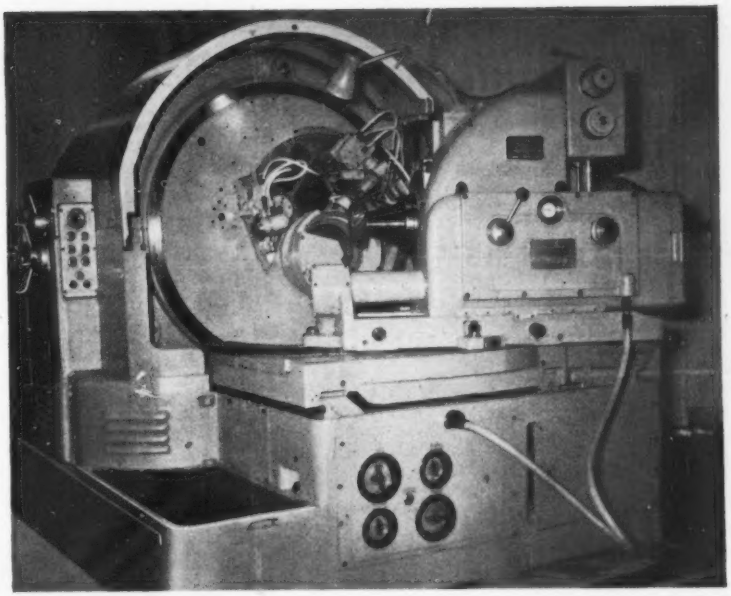


Fig. 5. For Finishing Spiral Bevel Gears, ENIMS Research Institute has Developed this Grinding Machine. It is Hydraulically Operated, and the Cup-type Wheel is Dressed Automatically

with the machine base. The working area of the machine is normally enclosed by guards, which are supported on the arcuate members at the front, but, in the illustration, these guards have been removed for the sake of clarity. A ram, that projects from the housing at the extreme right-hand end of the bed, carries the twin-diamond dressing unit, which is positioned below the grinding wheel.

Other metal-cutting machines at the exhibition include lathes, milling machines, boring machines, gear hobbers and a small in-line transfer machine. There is also a rotary transfer machine, with five unit heads for vertical and horizontal drilling, and for milling.

METAL-FORMING EQUIPMENT

Among the metal-forming equipment displayed is a multi-slide machine for the production of nails at a rate of 800 per min., and the bolt-making machine seen in Fig. 7. The latter unit is built by the Odessa Machine-tool Plant, and will produce bolts at a rate of 90 per min. Bolts can be made with shanks diameters up to 8 mm. (0·315 in.), and with lengths from 15 to 50 mm. (0·590 to 1·968 in.).

In Fig. 8 is shown a Voronezh single-acting

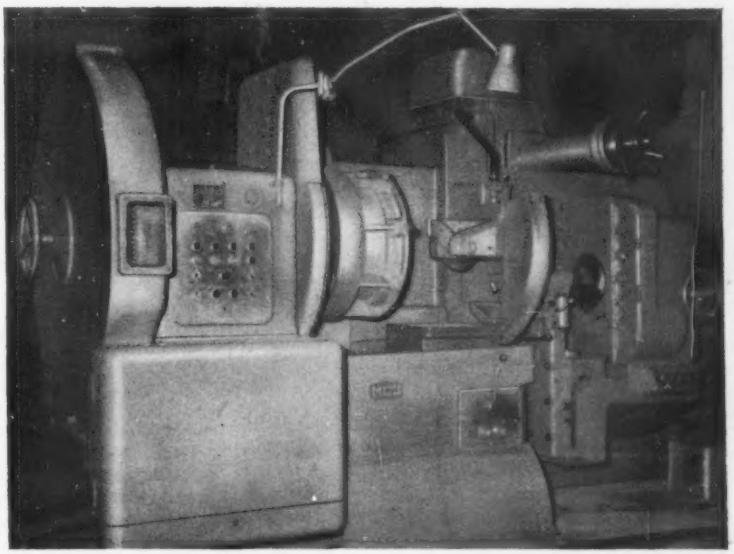


Fig. 6. This New Machine for Grinding the Teeth of Internal Gears has been Built by the Moscow Grinding Machine Plant for Gears of 100 mm. Face Width and 600 mm. Maximum Diameter

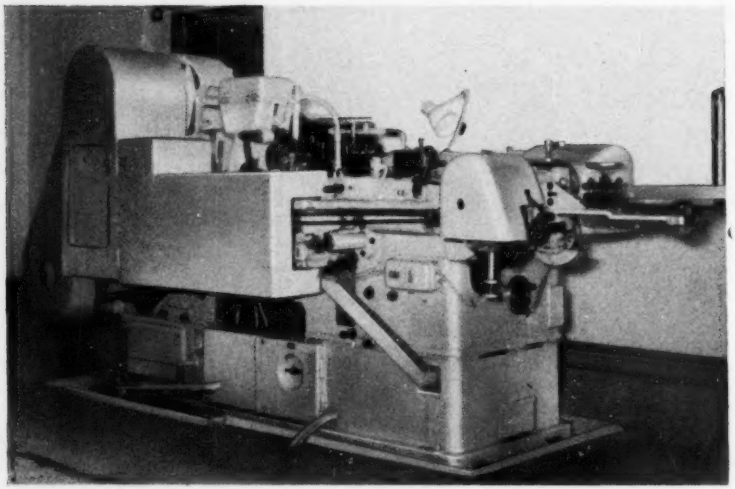


Fig. 7. A New Bolt-making Machine Built by the Odessa Machine Tool Plant, which has an Output Rate of 90 Pieces per min.

power press, of the twin crankshaft type, which has a capacity of 160 tons. Drive is transmitted from a motor of 27 h.p., mounted on top of the press frame, through an air-operated clutch to the crankshaft driving gears, and the maximum speed of operation is 22 strokes per min. The press frame is of welded steel plate construction, and the bolster measures 2,000 by 1,250 mm. (78¾ by 49¼ in.). The ram has a stroke of 400 mm. (15¾ in.), the maximum distance between the lower face of the ram and the bolster is 750 mm. (29½ in.), and there is screw adjustment of the ram through a distance of 315 mm. (12⅜ in.). Interlocked push-button controls are provided on each upright, and there is a pedal on a flexible lead for remote operation. In addition, photo-electric guarding units are fitted to the openings on both sides of the press frame, so that the clutch controls are ineffective until the loading workers are completely clear of the tool area. A pneumatic cushion is incorporated in the base which exerts a pressure of 32 tons.

In addition to the groups of exhibits which have been mentioned, there is a section of the machine-tool pavilion devoted to foundry equipment. Here, is displayed a selection of mould-making and core-making machines, which, generally, are of orthodox design and construction.

At one time, most of the machine-tool plants of the Soviet Union were concentrated in the neighbourhoods of Moscow and Leningrad. Since the second world war, however, new plants have been established in other parts of the U.S.S.R., as indicated in the descriptions of the foregoing machines. There is still a number of important machine tool factories in the Moscow and Leningrad areas, and the activities of certain of these plants, also of two of the most important research stations associated with machine tools and a cutting-tool works, will be considered in later articles in this series, to be published shortly in MACHINERY.

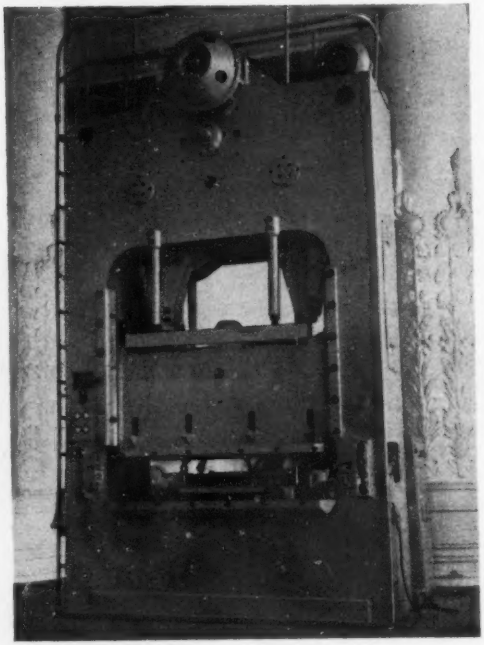


Fig. 8. This Voronezh Single-acting Press has a Frame of Welded Steel Plate, an Air-operated Clutch and Photo-electric Guarding Arrangements. It Exerts a Pressure of 160 tons, and can be Operated at Speeds up to 22 strokes per min. A Pneumatic Cushion is Incorporated in the Base

Operations on the Jameson Universal Production Aerofoil Generating Machine

An article in MACHINERY, 92/876—18/4/58 was concerned with the design and principle of operation of the large universal production aerofoil generating machine which has recently been built by J. L. Jameson, Ltd., Ewell, Surrey, and the manner in which a single point planing tool is used, in conjunction with master templates representing the projected tip and root profiles of the finished wing skin panel, to generate the required aerofoil form. A cut is taken at each pass of the tool-box, and the latter is traversed by means of a 5½-in. diameter, 7½-in. lead, screw, driven through a 3-speed epicyclic gearbox by a variable-speed, 25-h.p., D.C.-motor.

This drive arrangement provides a tool-box traverse speed range from 300 ft. per min. to 2½ in. per min., and, as was mentioned in the earlier article, it was necessary to provide such a wide range of traverse rates because the machine is also equipped to undertake certain milling operations. A milling attachment is provided so that run-out pockets can be machined in the underside of the skin panel, to permit the subsequent spanwise planing of stringers, for example, and feed motion for this attachment is taken from the same screw that traverses the planing tool-box.

FITTING AND POSITIONING THE MILLING ATTACHMENT

In Fig. 1 is shown a close-up view of the pivoting tool-box used for planing, and here may also be seen two of the seven bearings which are spaced at 4-ft. 6-in. centres to support the 27-ft. long traverse screw. To fit the milling attachment, the planing tools and the wedge-shaped clamping piece and bolt are removed from the tool-box, with the result that the front face of the latter, which, it may be noted, is approximately ¼ in. behind the faces of the upper and lower plates *C* and *D*, is free from projections. The upper edge of the plate *C*, and the lower edge of the plate *D*, are chamfered for their full width to form a dovetail slide, and, as may be seen in Fig. 2, the right-angle bracket saddle *E*, for supporting the milling head, has mating slideways on the rear face. Indicated at *F* in this illustration, is one of a pair of flat plates which are bolted to ends of the saddle *E*, and these plates carry hexagon-head bolts which can be screwed in to make contact with the end faces *A* and *B* of the planing tool-box, Fig. 1. With the milling attachment saddle locked to the tool-box in this manner, the 63:1 reduction ratio of the epicyclic gearbox is engaged, which, in conjunction with the 20:1 speed range of the D.C.

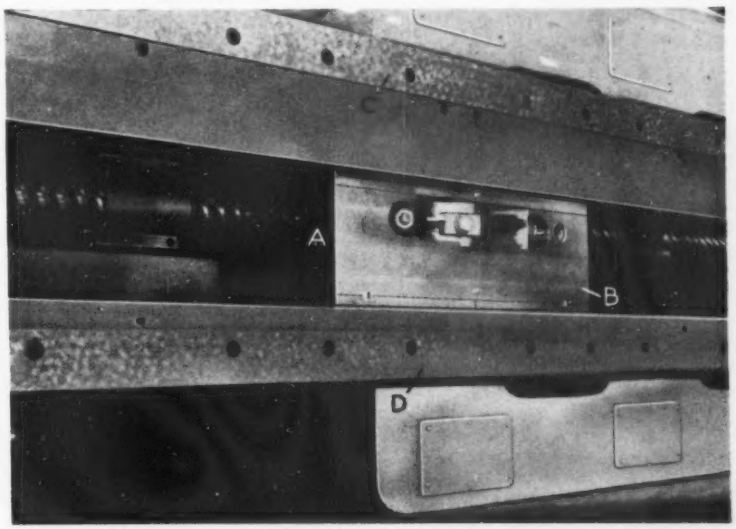


Fig. 1. Close-up View of the Planing Tool-box. The Pivoting Tool-holder Allows a Cut to be Taken in Each Direction of Traverse. Here also May be Seen Two of the Seven Bearings which are Employed to Support the 5½-in. diameter, 7½-in. lead, Traversing Screw

motor, provides traverse rates for milling ranging from 2½ to 50 in. per min.

Referring again to Fig. 2, it may be noted that a transverse movement is provided for the milling head, adjustment being obtained by means of the hand-wheel seen at the bottom right. Six spindle speeds are provided by the all-geared head, ranging from 500 to 3,000 r.p.m., and drive is taken, through V-ropes, from a 10-h.p. constant-speed motor. The milling spindle has a 40-series nose and the cutters may either be bolted directly to the front face or held in a suitable collet. All the cutters which were used during the milling trials on this machine were supplied by Clarkson (Engineers), Ltd., King Edward Road, Nuneaton, and were of the Autolock and Dedlock types.

As already mentioned, the milling attachment is intended, in general, for producing run-out pockets adjacent to chord-wise ribs, in preparation for span-wise planing, but the exact method adopted for machining the stringers and ribs on the underside of a wing panel will depend largely on the design and dimensions. On the Jameson machine, the maximum span-wise length that can be accommodated is 24 ft., and the maximum chord-wise width, 8 ft. In considering wing panels from the standpoint of machining, it has been found that designs fall into one of three broad catagories.

For those wings which have a chordal rib spacing of less than 48 in., pocket-milling and subsequent short-stroke planing is not usually economic, and the whole of the material between the ribs and stringers is removed by the milling process. In this instance, templates representing the rib profile at a particular station are used, and the tool slide, with the milling head attached, is positioned against these templates, as when planing.

For wings with ribs spaced at intervals of 48 in. or more, pocket-milling and short-stroke planing can be carried out, templates representing the local rib profile being used during the milling operation. It has been found, however, that for a wing panel with less than 15 deg. included span-wise taper, and stringers at 6-in. spacing, or less, the extra templates, just mentioned, can be dispensed with, since the milling operation can be carried out quite successfully with the existing tip and root templates which were employed for the planing process. With the third type of wing panel, which has no chord-wise ribs, the stringers are planed straight through, and no milling operation is required.

It may be mentioned at this point that, as this is essentially a template-controlled generating machine, no measuring screws are incorporated. The wing plank is fully marked-out in position on the worktable, by substituting a spring-loaded scriber for the planing tool and picking up the stringer positions by means of the knife-edges and suitable templates, in the same manner as when planing.

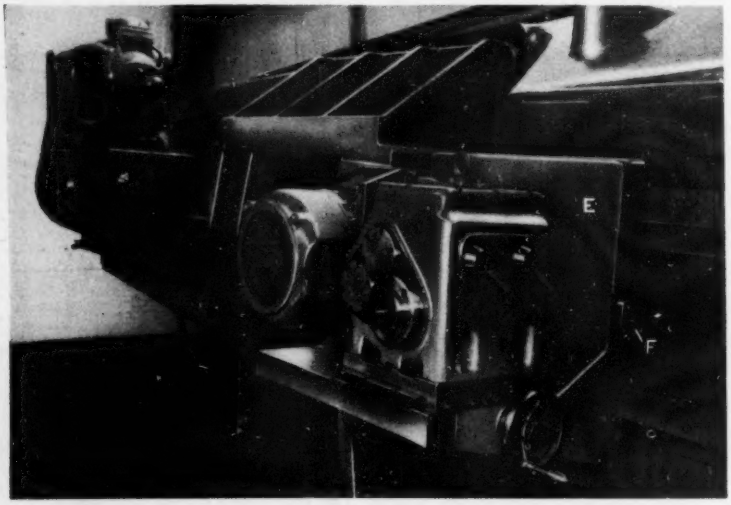


Fig. 2. Close-up View of the Milling Attachment in Position on the Front of the Tool-slide. The Saddle *E* Engages a Dovetail Slide Formed by the Retaining Plates *C* and *D*, Shown in Fig. 1

In Fig. 3 can be seen the under-side of a large aluminium alloy panel on which a number of experimental planing and milling cuts have been taken. The panel would normally be held by a vacuum chuck, bolted to the pivoting worktable. The latter complete with its trunnion mountings, has been withdrawn from the normal working position to enable the photographs to be taken. Two of the transverse beds on which the trunnion mountings are traversed are also visible in this illustration, and in the throat of the nearer bed, which is in the centre of the machine, the inner end

bearing and thrust collars for the traversing screw can just be seen. The large casting at the left of the figure is the tool-slide, which is here shown almost fully extended towards the worktable. The aerofoil form of the area between the stringers can clearly be seen on the end of the panel nearest to the camera, and the lowermost stringer has been planed down to the finished size of 0·156 in.

Fig. 3. The Under-side of a Large Aluminium-alloy Test-piece on which a Number of Experimental Planing and Milling Cuts have been Taken. The Aerofoil Form of the Area between the Stringers can Clearly be Seen on the End Nearest to the Camera

SETTING-UP THE WORKPIECE

When positioning a workpiece on the table, consideration is given to the amount of span-wise taper which is required, so that the total angular movement of the swivelling-beam may be distributed, as evenly as possible, above and below the horizontal. In addition, the condition and dimensions of the blank must be taken into account, so that any existing inaccuracies or imperfections can be avoided or accommodated. These requirements can be met by a combination of the final position of the blank on the table, and the relative positions of the templates to each other, and to the blank. It will be realised that the position of the workpiece relative to the swivelling beam is, within reason, of little or no importance, as the location of the latter, and its tool-slide, is governed finally by the templates. In effect, therefore, the workpiece is clamped to the table in any convenient position, an effort being made to distribute the angle of span-wise taper evenly, above and below the horizontal, and the tip- and root-section templates are then adjusted, relative to the workpiece, in order to obtain the best result from the raw material.

Final length-wise location of the blank on the table is determined largely by the size of the blank, and by the distance between each end and its associated template. The centre distance of the two templates is of obvious importance, as is their position, as a pair, relative to the central and tapering screws. To facilitate this latter setting, the joint face of the two halves of the work table has been arranged coincident with the centre elevating screw, and may be used as a datum for measuring.

The close-up view, Fig. 4, shows the left-hand template with the associated knife-edge in contact with its formed surface, and here also may be seen the locating hole G in the centre of the template-carrier. This hole is carefully aligned with a similar hole in the other carrier, and as there is a corresponding accurately-positioned hole in the centre of each template, it is thus ensured that the two templates are correctly located, vertically, relative to each other.

TRACER-VALVE-CONTROLLED TOOL-SLIDE

Since the previously-mentioned article was published in MACHINERY, the builders of the machine have reported that certain design improvements have been made as regards the manner in which the knife-edges are applied to follow the form of the templates. As previously described, the knife edges were rigidly-mounted on brackets secured to the front of the tool-slide, and, after each span-wise planing cut, the tool-slide, and consequently the knife-edges, were relieved approximately $\frac{1}{16}$ in. With this arrangement, the knife-edges were

removed from the templates while the swivelling-beam was automatically adjusted for height and inclination, and then advanced to engage the templates again, for a fresh cut in the opposite direction. As can be seen from Fig. 4, which is a close-up view of the left-hand knife-edge and template, the follower is now carried on the spool of a hydraulically-operated tracer valve *H*. This valve, the pipe connections and flexible hose for which are visible in the foreground, is flange-mounted to the plate *J*, which is located from the dovetail-section retaining plates on the front of the tool-slide in the same manner as the milling head attachment.

The tracer-valves, of the firm's own design and manufacture, are connected to the two double-acting hydraulic cylinders employed for advancing and retracting the tool-slide, and the knife-edges are spring-loaded in constant contact with the templates. As a feed increment is applied to the swivelling-beam by automatic adjustment for height and inclination, the knife-edges are moved to fresh positions on the templates. Consequently, the knife-edges move axially, due to contact with the templates, and as they are fixed to the outer ends of the tracer-valve spools, the latter are moved likewise. These movements are transmitted to the double-acting hydraulic cylinders, just mentioned, and the tool-slide is automatically brought to the required position.

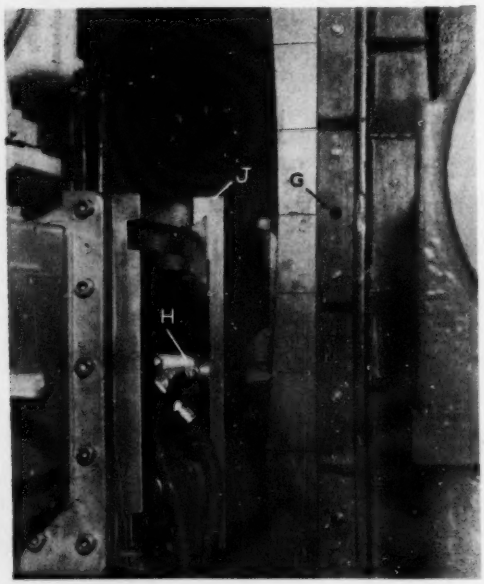


Fig. 4. Close-up View of the Left-hand Template Carrier, and Knife-edge. The Plate *J*, which Carries the Tracer-valve and Knife-edge, is Located on the Dovetail-section Retaining Plates in the Same Manner as the Milling Attachment Seen in Fig. 2

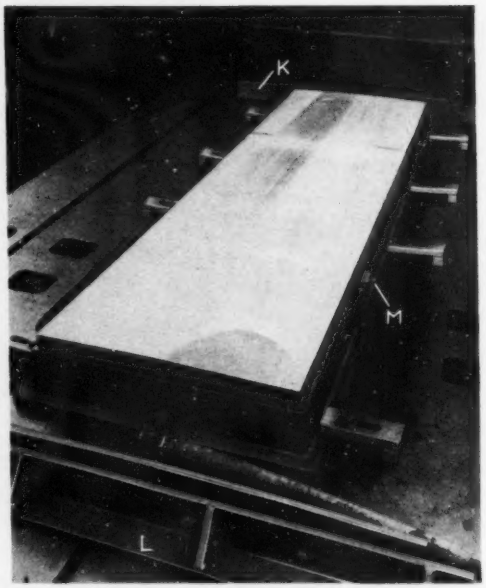


Fig. 5. A Short Aluminium-alloy Panel in Position on the Vacuum Chuck on the Worktable. In this Instance, the Template Carriers are Bolted Directly to the Worktable. The Main (Left-hand) Template-carrier can be seen in the Background. The Worktable is here shown in its Horizontal, or Loading, Position

The incorporation of a tracer-valve control has eliminated the need for relieving the knife-edges from the templates, and the length of the pause at the end of each cutting stroke has been reduced accordingly. The plate *J*, Fig. 4, and the similar member at the other end of the tool-slide, can be adjusted longitudinally to suit the centres of the template carriers, which, when short panels are being planed, take the form of separate brackets mounted directly on the surface of the worktable. A pair of these brackets can be seen at *K* and *L* in Fig. 5, which is a view of a short aluminium-alloy panel on which a preliminary planing cut has been taken. The main (left-hand) template carrier can be seen in the background, and in the foreground may be noted the flexible connection

for the vacuum chuck. Four adjusting screws *M*, provided for positioning the blank, are carried in flat plates which are bolted to the side of the chuck body.

Attention is drawn to the machining marks on the top surface of the workpiece, which indicate the amount of span-wise taper present on the finished blank, and to the fact that, at this stage, the long sides of the workpiece are parallel. In Fig. 5, the worktable is in the horizontal, or loading, setting.

CONTROL OF THE MACHINE

With the wing plank in position on the table, and the templates adjusted in relation to it, in the manner described, all the movements and operation of the machine can be controlled from the operator's desk shown in Fig. 6. This desk, which, in common with all the electrical control gear, was supplied by Allen West, Ltd., Brighton, incorporates a speed control knob *N* for the 25-h.p. variable-speed tool-box traversing motor, and a twin-scale tachometer *P*. The inner scale of this instrument is graduated from 0 to 300 ft. per min. to indicate the traverse speed of the planing tool-box, in either direction, and the outer scale, which has in. per min. markings, registers the feed rate of the milling attachment. The two pairs of push-buttons immediately to the left of the knob *N* are of the hold-to-run type, the upper pair controlling the motor which pivots, and the lower pair, the motor which traverses, the worktable.

To the right of the knob *N* can be seen the master rotary switches for controlling those movements which normally form part of the automatic cycle of the machine, such as the hydraulic clamping of the swivelling-beam and the tool-slide. The group of push-buttons in the bottom right-hand corner of the desk is used for initially-positioning the swivelling beam for height and inclination, and for engaging the automatic vertical feed motion for this member, in both directions. Pilot lights are provided to indicate which direction of feed traverse has been engaged.

All the master buttons on this desk, and those which are connected with the positional movements of the machine, are duplicated on a pendant control accessible from a platform on top of the right-hand column. This platform offers a useful vantage point from which the operator can watch the tool-box and the face of the component during the start of a cut, and check that the stroke limit-dogs, for example, have been set correctly.

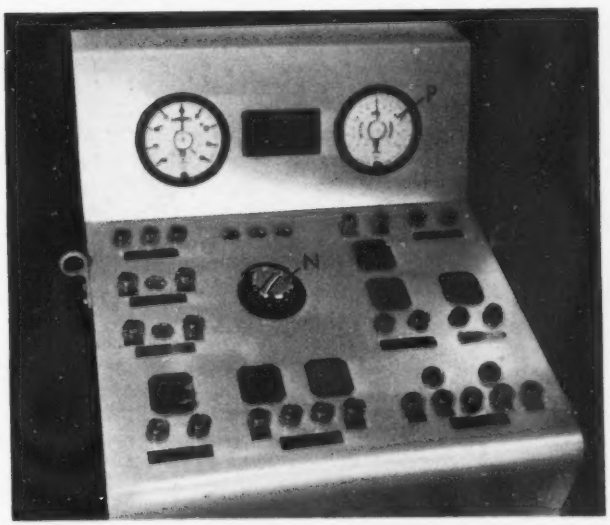


Fig. 6. A Close-up View of the Main Operating Control Desk

AQUACEL STRIPPABLE COATING—A new strippable coating, known as Aquacel, has recently been introduced by Croda, Ltd., Cowick Hall, Snaith, Goole, Yorks., to provide protection against scratching, splashing or similar marring of highly-finished surfaces, particularly those that have been painted. It serves also as a masking medium, and protects plated and polished surfaces against marring by finger-prints and grease.

The basis of the new protective coating is a water-soluble polymeric material, which is very resistant to solvents, oils and greases. Aquacel is a water-white, transparent liquid, with a covering capacity of 210 to 220 sq. ft. per gal., and dries in 1½ hours. Although the stripped coating burns fairly readily, the material will withstand a temperature of 130 deg. C. for 1½ hours. In its liquid form, Aquacel is non-inflammable.

As supplied, the coating can be applied by brushing, but is usually sprayed on to the surfaces to be protected, after it has been thinned with water, to a viscosity of about 30 sec. (Ford Cup No. 4). Any tendency to lumpiness on thinning can be overcome by adding about 0.5 per cent of Teepol. It can be stripped readily, or can be removed by washing with water. Due to its high water content, Aquacel cannot be stored in ferrous metal containers.

Production of Titanium Rings from Extruded Sections*

By NEIL J. FIOLA†

The high strength-to-weight ratio of titanium and titanium alloys makes possible considerable weight savings in aircraft components where these materials are substituted for fairly lightly stressed and/or corrosion-resistant steels. In their efforts to take advantage of these potential weight reductions, however, aircraft companies have been greatly hindered by the high cost of finished titanium parts. Indeed, when conventional manufacturing methods are employed, the cost of titanium parts may be as much as ten times that of corresponding steel parts. This ratio is attributable to the high cost of raw titanium material and to the low material utilization factors‡ achieved with the normal methods of production. Low utilization may be tolerated for comparatively inexpensive steel, but with titanium the loss of expensive raw material in the form of unreclaimed scrap is an important consideration.

Under contract from the Air Materiel Command of the U.S. Air Force, the Curtiss-Wright Corporation have recently developed manufacturing methods which permit much higher material utilization with corresponding reductions in the cost of finished part costs. These methods depend primarily on the extrusion process.

To assess the possibilities of the new methods, typical ring components were made in unalloyed titanium (AMS 4921) and in the 5 per cent Al. 2½ per cent Sn (A 110 AT) titanium alloy. In an aircraft propulsion unit, these rings form end flanges for sheet metal assemblies, Fig. 1. When these flanges are made by conventional techniques, such as forging, or bending and welding barstock, the blank sections are grossly oversize. By the newly-developed extrusion method, these rings were made as follows: (1) Material of the cross-section required was extruded in straight lengths with a minimum machining envelope; (2) the extruded lengths were contour formed into rings and flash-butt welded; and (3) the rings were sized and finally machined to finished dimensions. As a result, only 50 per cent of the raw material (in the form of cast ingots) was required to produce the finished part as compared with that needed for conventional manufacturing methods. Additional cost savings were obtained by extruding these sections directly from cast ingots.

* Abstract of a paper presented at the recent annual meeting of the Society of Automotive Engineers, U.S.A., under the title "The Manufacture of Engine Parts at Lower Costs by Extrusion."

† Wright Aeronautical Division, Curtiss-Wright Corporation.

‡ The material utilization factor is the ratio of the finished part weight to the raw material weight.

EXTRUSION

Since the extrusion process is the key to the new manufacturing method, the greater part of the

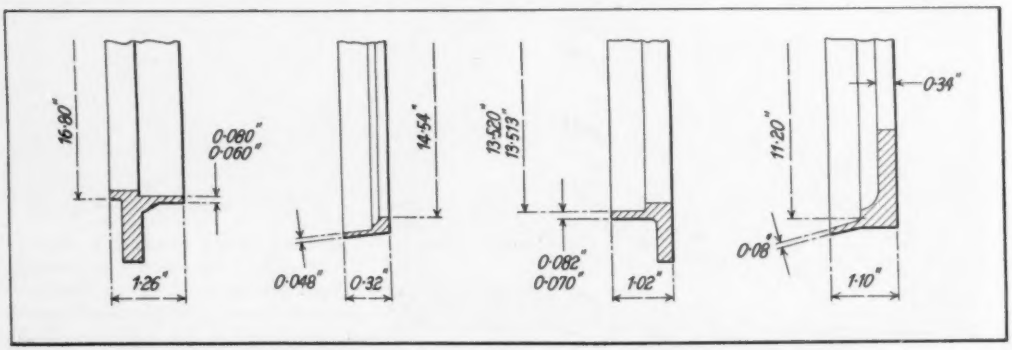


Fig. 1. Representative Cross Sections of Rings Produced from Titanium Forgings

development work was concentrated on this operation. The investigations were carried out with a 12,000-ton horizontal extrusion press installed in the works of the Metals Processing Division of Curtiss-Wright, in Buffalo, New York. Containers are provided for this press which will permit the extrusion of billets ranging in diameter from 8 to 24 in. When using containers of different sizes, forces of 4,000, 8,000 and 12,000 tons can be exerted. For this investigation, a force of 4,000 tons and an 8-in. diameter container were used exclusively. The billets were heated in readiness for extrusion in a barium chloride salt bath located close to the press. For rapid transfer of the billet from the furnace to the extrusion chamber, an overhead hoist was employed.

Representative cross-sections of the rings which formed the subject of the investigation are shown in Fig. 1. For the extrusion cross-sections, approximately 0·050 in. was added on all surfaces to provide for the tolerances necessary for the extrusion operation, and to permit machining to the finished dimensions after the rolling, welding, and sizing stages.

To determine the allowance needed solely for the extrusion operation, the effects of the extrusion process variables were studied in connection with round bars. The purpose of this study was to determine the lowest tolerances that would suffice and the maximum extrusion yield obtainable. Optimum surface finish was achieved with the following conditions.

—	A 70	A 110 AT
Extrusion speed	450 in. per min.	—
Lubricant	Fiske No. 630[1]	—
Container temperature	800 deg. F.	—
Die pre-heat temperature	750 deg. F.	—
Die material	Vasco Supreme[2]	—
Die design (entrance angle)	120 to 140 deg.	180 deg.
Billet heating	Salt bath	—
Billet temperature	1,550 deg. F.	1,850 deg. F.

1 Calcium base soap with graphite, vermiculite, and calcium carbonate.
2 Composition: 1·57 C; 4·75 Cr; 5 V; 0·25 Mn; 5 Co; 12·5 W; 0·25 Si.

These conditions resulted in an extruded product, for both the A70 and A 110 AT materials, with the following tolerances:

Nominal metal dimension	Extrusion tolerance
Less than 1·00 in.	± 0·020 in.
1·00 to 2·00 in.	± 0·030 in.
2·00 to 3·00 in.	± 0·040 in.

This dimensional control can be maintained for lengths of 100 linear ft. for the A70 material and 15 linear ft. for the A 110 AT alloy. For the A70 material, the 100 linear ft. was obtained with five 20-ft. extrusions. This length limitation is imposed directly by die wear, which is much more severe when the A 110 AT alloy is being extruded. Undoubtedly, as better die materials and lubricants are developed this problem of rapid wear will be overcome.

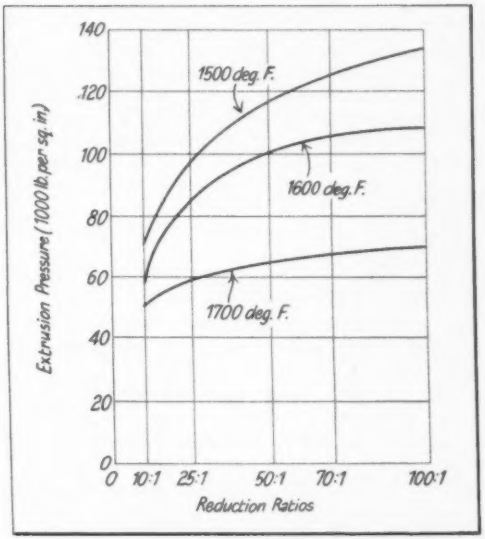


Fig. 2. Pressures Required for Extruding A70 Titanium at Various Temperatures

The difference in die life for the two materials affords an indication of the greater resistance to deformation offered by the A 110 AT alloy. Substantially greater pressures were required for extruding this material as compared with A70, even at the higher temperature (1,850 deg. F. as compared with 1,550 deg. F.). The high pressures necessary considerably restricted the range of possible extrusion temperatures, and the reductions obtainable with the A 110 AT alloy.

Curves showing extrusion pressures for the A70 material for various extrusion temperatures and ratios are given in Fig. 2.

MECHANICAL PROPERTIES IN EXTRUDED SECTIONS

It was previously mentioned that a substantial additional cost saving could be obtained by employing cast ingots for the extrusion stock. Conventional extrusion practice involves the use of a billet which has been forged from an ingot to fit a

container of a certain diameter. By extruding directly from a cast ingot, both the cost of the forging operation and loss of material at this operation are avoided. Since this procedure represented a new technique, considerable development work was required to determine the quality of such extrusions, and the effects of extrusion temperatures and extrusion ratios on the mechanical properties of cast ingot extrusions were carefully investigated.

The results of various trials indicated that tensile properties well in excess of the minima specified could be obtained by extruding A70 and A 110 AT materials at 1,550 deg. F. and 1,850 deg. F., respectively, with extrusion ratios of 10 : 1 or greater. Typical tensile values for these extrusions are given below:

	A 70	A 110 AT
Tensile strength, lb. per sq. in.	100,000	135,000
0·2 per cent yield strength, lb. per sq. in.	80,000	120,000
Elongation, per cent	25	20
Reduction in area, per cent	40	35

Attention is here drawn to the importance of extrusion temperature. For the materials studied, extrusion at a temperature above the beta transformation point (A70, 1,625 deg. F.—A 110 AT 1,930 deg. F.) may result in a severe loss of ductility and consequent embrittlement. These temperatures, therefore, represent the upper limits. The lower limits for extrusion temperature are established by the pressure requirements. The previously quoted temperatures of 1,550 and 1,850 deg. F. represent a compromise.

To afford further evidence of the high quality of the cast ingot extrusions a comparison was made with extrusions from forged billets. This comparison is presented graphically in Fig. 3.

CONTOUR FORMING

The extruded shapes were formed into complete rings on a Bath radial draw former. This machine incorporates a power-driven circular table and a double-acting cylinder with controlled pressure. Where required, a hydraulic ram is utilized, which is capable of applying a side force to the section while it is being formed.

Heating of both the dies and material was necessary for forming all the shapes investigated, in both materials. For A70 titanium, the material temperature was 700 to 1,000 deg. F., and the die temperature 800 deg. F. The corresponding figures for the A 110 AT alloy were 1,200 to 1,400 deg. F., and 1,000 deg. F.

The exact temperature required for each type of ring was found to depend on the complexity of the cross-section and the ring diameter. As indicated, however, the temperature required to form the A 110 AT rings was generally higher than that required for the A70 material. Forming at too low a temperature resulted in tearing of the ring on the side which was in tension.

In all cases, the best results were obtained when the forming operation was carried out as slowly as possible. It may also be noted that 2-pass forming was found to be desirable, the table being rotated first in one direction and then the other.

FLASH-BUTT WELDING

Welding of the formed titanium rings was carried out with a Thomson F-4 Synchromatic machine rated at 250 kVA., with a maximum clamping force of 23,000 lb. and a maximum upset force of 32,000 lb., and a Swift machine of 600 kVA. with maximum clamping and upset forces of 160,000 lb., and 200,000 lb., respectively.

Initial tests were carried out with machined bar stock to determine the range of rib ratios between

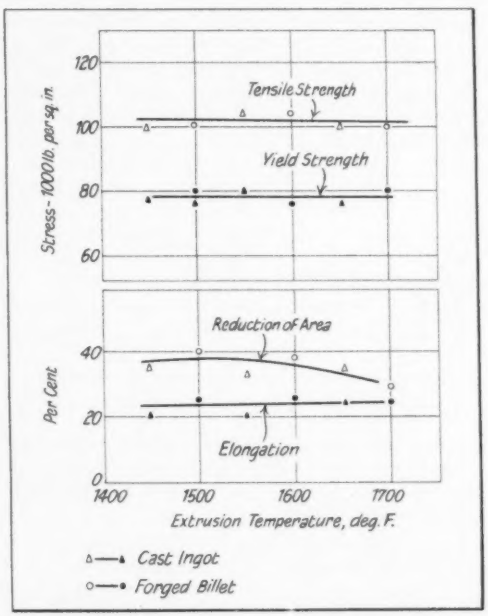


Fig. 3. In these Graphs the Mechanical Properties of Titanium Extrusions from Cast Ingots and Forged Billets are Compared. The Extrusion Ratio was 33 : 1

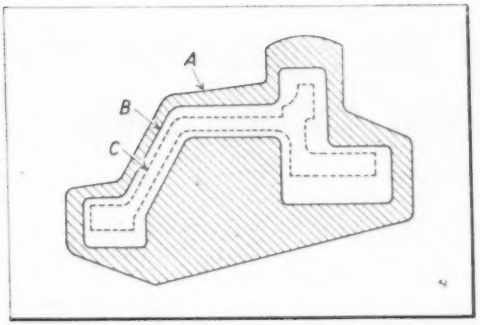


Fig. 4. Machining Envelope Comparison for Production by Forging and Extrusion. *A*—Forging. *B*—Extrusion. *C*—Finished Section

the thick and thin portions of a complex section, which could be flash-butt welded, while meeting the strength and ductility requirements of the appropriate specification (AMS 7498 – Tensile strength through weld area 95 per cent, and elongation 50 per cent of that of the parent metal). High quality welds were obtained for rib ratios as large at 5·3 to 1. This ratio is much greater than for any of the rings studied (see Fig. 1).

The machine settings established for the different shapes varied considerably. The following are typical values for some of these settings: initial die opening, ¾ to 1½ in.; final die opening, ½ in.; flash burn off, ⅜ to ½ in.; upset force, 20,000 to 30,000 lb.; flash time, 3 to 12 sec.; burn off length, ¾ to 1¼ in.; and clamping force, 23,000 lb. The individual machine settings used were checked by X-ray and tensile tests.

SIZING

All the titanium rings were expanded on a 225-ton press. A range of sizing temperatures from 700 to 1,250 deg. F. was employed for both materials. These temperatures permitted expansion of 2 per cent and 1½ per cent for the A70 and A 110 AT materials, respectively. With the small diameter, large cross-section rings, an out-of-roundness resulted from welding. Prior to sizing these rings, a rolling operation was performed to restore concentricity.

ECONOMICS OF THE PROCESS

The higher material utilization associated with the production methods here described, coupled with the use of cast ingots for extrusion, resulted in an appreciable reduction of costs as compared with conventional forging techniques. For the various shapes examined, cost savings were generally of the order of 25 per cent, and in some instances were as high as 40 per cent. An additional advantage was that the overall time required for providing detail parts was reduced by 30 per cent.

The results are summarized in the following table:

Manufacturing method	Conventional forging	Extrusion	
		From forged billet	From cast ingot
Material utilization.....	19	26	30
Part cost (dollars per lb.)	72	48	43
Cost savings (per cent)	—	33	40
Procurement time, months	6	5	4

The above figures do not include the savings obtained at the machining stage. Rings manufactured by the method described require approximately one-half the stock removal necessary with conventionally forged sections, as indicated in Fig. 4. In general, this reduction results in an additional saving of approximately one-fourth to one-third of the former machining costs.

In conclusion, it should be pointed out that the advantages of the process described are not confined to ring components. The higher material utilization will be of value in connection with the production of other detail shapes, for example, for airframe structures, and for obtaining pre-forms for other "chipless machining" techniques.

Extrusion, however, will not solve all the problems of reducing costs of titanium parts. Where the geometry of the component does not lend itself to this procedure, similar development of other fabrication techniques will be necessary, all of which must provide for high material utilization.

NEW LOCKHEED COMPUTER—The Lockheed Aircraft Corporation, Burbank, Calif., U.S.A., has recently installed a new electronic computer in the missiles division, at a cost of £540,000, in order to expedite work on two of the company's projects. One of these projects is concerned with the Polaris missile for the U.S. Navy, which is designed for launching from submerged submarines, and the other is connected with a reconnaissance satelite, with a recoverable capsule, for the U.S. Air Force. The new computer, and its associated equipment, occupy 1,900 sq. ft. in a special computer centre, which has cost £1,250,000.

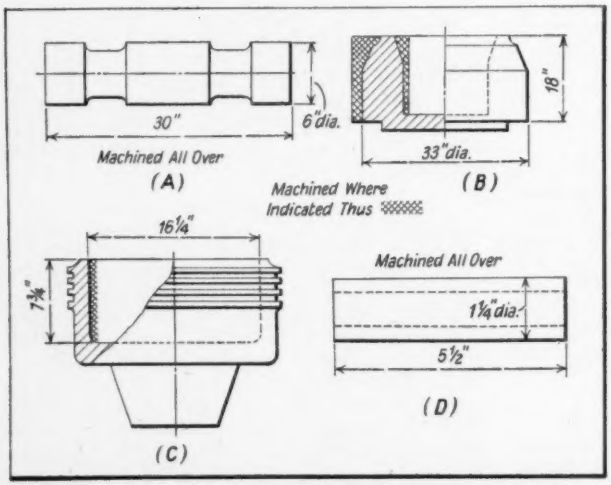
Practical Examples of the Application of Ceroc Sintered Ceramic Cutting Tools

By G. H. NASH

In MACHINERY, 91/1420—20/12/58, reference was made to the development and some initial applications of Ceroc sintered ceramic cutting tools, which are now being produced by the Compagnie Générale d'Electro-Ceramique. These tools are now being successfully employed on continuous production in a number of French factories, both large and small. The writer has had the opportunity of studying these applications at first hand, and it is of interest to note that, in the majority of cases, the machines used are at least eight years old. Some of these machines were in good condition, but the standard of others could only be described as fair. Even under such operating conditions, which are at variance with those generally recommended for the application of ceramics, good results have been achieved. It should be emphasized, however, that powerful modern machines, of robust construction, are necessary if ceramics are to be used to the best advantage.

Contrary to the widely accepted idea that ceramic tools are unable to withstand shock-loads, Ceroc tools have proved to be capable of taking interrupted cuts, as indicated by the following example. A block of 45-ton steel, of 7- by 8-in. section and 6 in. long, with a 2-in. diameter hole drilled through the centre, was held in a 4-jaw chuck on a centre lathe. This lathe, which was 20 years old, was driven by a 12-h.p. motor. A facing cut was taken at a work speed of 200 r.p.m., a feed rate of 0·006 in. per rev., and a depth of cut of $\frac{3}{16}$ in. Due to the bad condition of the cross-slide, heavy vibration developed when the tool was cutting at approximately 4 in. diameter. Cutting was continued, however, and the facing operation was completed without damage to the tool edge. It may be noted that the work-material was sawn from a length of heavily-scaled black bar. The tip used was $\frac{1}{2}$ in. square, by $\frac{5}{16}$ in. thick, with the edge chamfered to suit roughing conditions, as explained in the article mentioned above.

In the following comparisons between the results obtained when using Ceroc and carbide tools, details of the condition of the machine employed in each instance has been given, as it is considered that such information is of interest. The various workpieces have been in production over a period of months in various French factories, and are shown in the accompanying figure.



Some Workpieces that have been Machined in French Factories with Ceroc Ceramic-tipped Tools

The component indicated at *A* was machined all over on a 15-h.p. centre lathe. This machine was in reasonable mechanical condition, and the turning operation was completed in three cuts. In this example, the work-material was 90-ton tensile steel, in the form of black bar. When carbide tools were used, the cutting speed was 300 ft. per min., the feed rate 0·012 in. per rev., and the depth of cut 0·080 in. From 10 to 15 components could be turned with each cutting edge. By using Ceroc tools, it was possible to increase the cutting speed to 590 ft. per min., with the same feed rate and depth of cut, and the number of components turned with each cutting edge was 25 to 30.

A 30-h.p. vertical boring machine, in reasonable mechanical condition, was employed for machining the workpiece *B*, which was made from non-magnetic steel, of 70-ton tensile strength. The cutting speed with carbide tools was 40 ft. per min., the feed rate 0·010 in., per rev., and the depth of cut 0·080 in. Each tool required regrinding after it had cut a length of 8 in. approximately. The cutting speed with Ceroc tools was 370 ft. per min., and with the same feed-rate and depth of cut as for the carbide tools, one complete ring could be roughed and finished with each cutting edge.

The third component, seen at *C*, is of cast iron, and was machined on a 20-h.p. vertical boring machine, in excellent condition. When carbide tools were used, the cutting speed was 270 ft. per min., the feed rate 0·005 in. per rev., and the depth of cut 0·060 in. Four workpieces were machined with each cutting edge. The same feed rate and depth of cut were used for Ceroc tools, but the cutting speed was increased to 1,000 ft. per min. Under these conditions, the number of components machined with each edge was 20.

A multi-tool lathe, in reasonable condition, was used for turning the workpiece *D*, which was machined from cast-iron tube, of 210 to 230 Brinell hardness. A feed-rate of 0·014 in. per rev., and a depth of cut of 0·1 in., were employed for both carbide and Ceroc tools, and with both tool-materials, 150 parts were machined with each cutting edge. For carbide, the cutting speed was 200 ft. per min., and for Ceroc it was 400 ft. per min. It is interesting to note that for this particular component, Ceroc tools were run at 600 ft. per min. for a number of days, and a life of 150 components per edge was maintained. The speed had to be reduced, however, since the machine tailstock tended to reach a dangerous temperature.

In addition to turning operations, Ceroc tools have been employed successfully for shaping. In one instance it was required to remove 20 mm. (0·787 in.) of metal from the face of a drop-forging die block. This operation was performed in two stages, and at the first, using a Ceroc tool, approximately 10 mm. (0·394 in.) of metal was removed from the hardened die surface. At the second stage, the remaining 10 mm. of metal was removed with carbide tools. For the Ceroc tool, a cutting speed of 82 ft. per min., a feed rate of 0·012 in. per stroke, and a depth of cut of 0·080 in. were employed.

At one point the surface was too hard for the above speed and depth of cut, and it was found necessary to reduce the cutting speed to 52 ft. per min. and the depth of cut to 0·040 in., the feed remaining the same. After 2-in. of the block had been shaped, the initial cutting conditions were resumed. The whole job was completed in 20 hours, without undue difficulty, whereas previously, for similar die blocks, 48 hours was required for shaping, when only carbide cutting tools were used. In addition to a saving of 28 hours in machining time, there was a considerable reduction in tool costs since when the first machining stage was performed with carbide tools, several were damaged.

Visits to French factories using ceramic tools have indicated that they are practical and efficient, and are being increasingly exploited on the Continent. Although, at this stage, ceramics cannot be used with complete success for all purposes, it seems probable that as their characteristics become more widely known, and the techniques of application are further developed, their field of usefulness will be progressively extended. The writer is indebted to Ugine-Carbone, who market Ceroc ceramic tips, and to Machine Tool Sales (London), Ltd., 79 Portland Place, London, W.1, their agents in Great Britain, for permission to use material included in this article.

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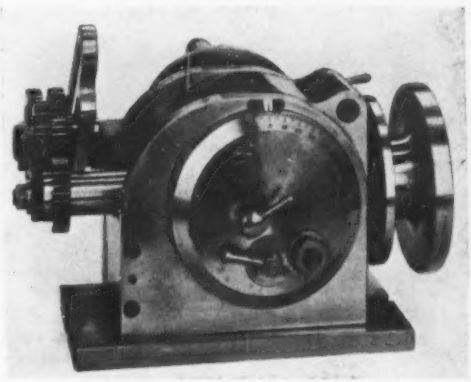
Apprentices of C.A.V., Ltd., Acton, W.3, were awarded first and second places in the London Association of Engineers Junior Challenge Shield competition for 1958. The accompanying illustration shows a view of a universal dividing head arranged for differential indexing which was made by Roger Mugford (aged 18) who was the winner. Colin Levi, who was second, submitted an indicator box comprising a degree marker and synchronized unit designed for testing fuel injection systems. It may be noted that C.A.V. apprentices gained first, second, and sixth places in 1957, and first place in the 1956 competition



Rotary Table with Optical Coincidence System

The optical rotary table, shown in Fig. 1, is intended for use on jig boring machines and similar equipment where very accurate circular spacing or angular positioning is required. The table can also be employed for inspection or calibration purposes. Made by the Pratt & Whitney Co., West Hartford, Conn., U.S.A., it incorporates a Gurley Unisec optical coincidence system which gives reading to 1 sec. of arc, with an overall accuracy of 3 sec.

This coincidence system is based on the principle of reading both sides of a circle at once, so that any errors due to eccentricity are cancelled. The circle is a 10-in. diameter optically polished disc, which is housed within the base of the table. The table and the graduated glass circle are secured to a common vertical shaft so that they rotate together.

As indicated in the diagram in Fig. 2, the glass circle has graduations near the rim. The graduations show increments of 10 min. of arc, and each degree is marked. For purposes of clarity, only the degree graduations are shown in the diagram.

From a lamp *A* in one side of the base, light is projected through two parallel tubes *B*. The inner ends of the tubes extend to points which are 180 deg. apart and directly over the graduations. Images of the graduations are projected back through the tubes. Then, through a series of prisms *C*, each beam of light is projected back on to a screen *D*, and the calibrations at opposite sides of the glass circle form two horizontal scales *E*, in a window on the right at the front of the base. In Fig. 1 the operator is observing this window, and in Fig. 3 is shown a close-up view of the window area.

When the table is rotated, the two scales move in opposite directions. Since the glass circle is graduated in steps of 10 min. of arc, and since the images on the screen move in opposite directions, the graduations coincide for each 5 min. of rotation. Figures can be seen at each degree line on the upper scale. Since figures on the lower scale would appear upside down, and since they would have no bearing on the reading, the mask of the window is purposely designed to hide them from view. An adjustable reference pointer extends across both scales.

At the left side of the window there is a vertical micrometer scale *F*, Fig. 2. This scale has a range of 5 min., and is graduated in seconds. It serves to subdivide the 5 min. between the points of coincidence of the two horizontal scales as the table is rotated. The optical system is so arranged that when the vertical image is moved, the lower horizontal scale moves in correct relation. No movement of the glass circle is involved in this adjustment, a deviating prism in the line of projection to the lower scale being employed to shift the position of the light

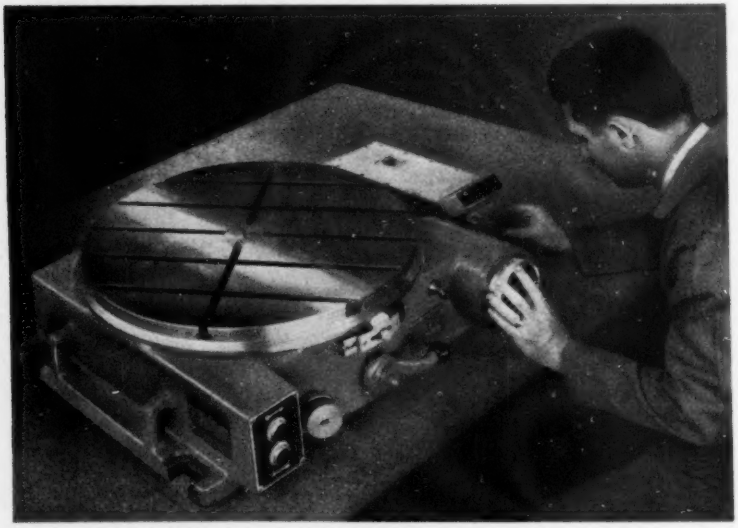


Fig. 1. Pratt & Whitney Precision Rotary Table with Gurley Unisec Optical System. By Reading Both Sides of a Circle at Once, Any Errors Due to Eccentricity are cancelled

beam from one side of the optical train.

There are 300 graduations on the micrometer scale. Every 10 sec. is marked on the left side, and the minutes on the right. In operation, the vertical scale is first set to zero by turning one of the knobs beneath the window, and the table is then rotated until the horizontal scales read zero. (If the nature of the work requires a definite starting position, the glass circle can be moved independently without disturbing the table setting.)

To index through a given angle, after a zero setting has been obtained, the vertical scale is set to show the minutes and seconds above the nearest figure divisible by 5 min. For example, for 15 deg. 23 min. 48 sec., the scale is set at 3 min. 48 sec., as indicated in Fig. 2. The table is then rotated beyond the 15 deg. 20 min. position until the graduations on the two adjacent horizontal scales appear to coincide.

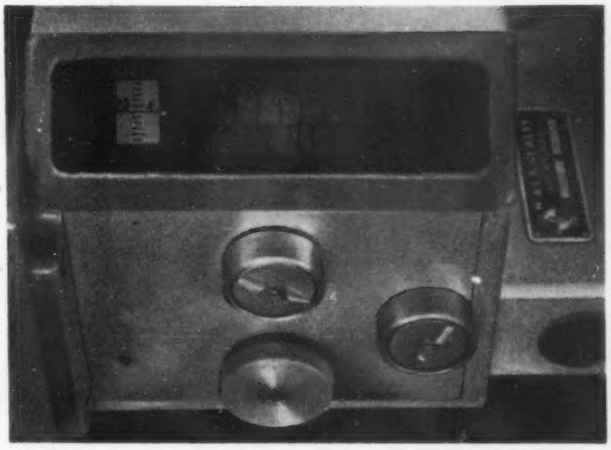


Fig. 3. A Close-up View of the Window Area of the Optical Rotary Table. The Vertical Scale has a Range of 5 min. and Gives Readings to 1 sec.

By a reverse procedure, it is possible to read any angle obtained when checking work. For this purpose, the vertical scale is advanced until the calibrations on the horizontal scales coincide. The reading on the vertical scale is then added to the angle shown on the horizontal scales.

If the nearest 10-min. calibration has passed the reference pointer, the vertical scale readings will increase until, at the mid-position, a full 5 min. is shown. Beyond the mid-position, the readings become smaller, and from this point until the next 10-min. graduation comes in line, 5 min. must be added to the angle which is shown on the vertical scale.

These Pratt & Whitney optical rotary tables, like the standard types made by the company, are arranged for power and manual rotation in both directions.

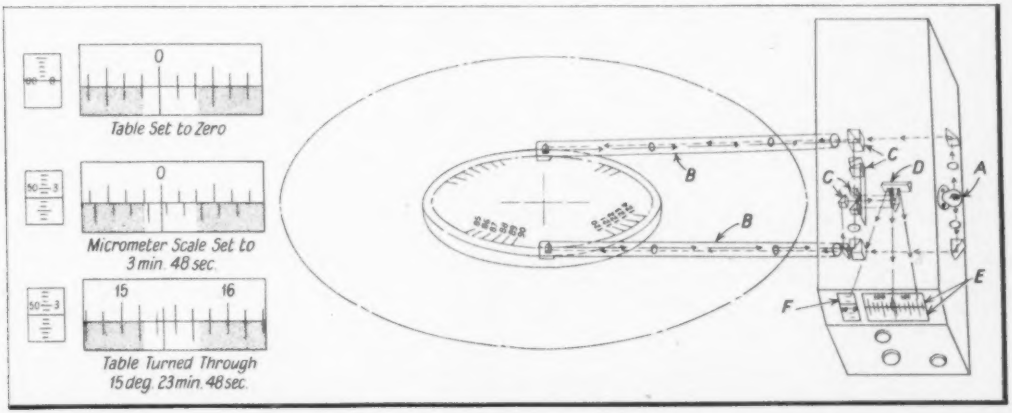


Fig. 2. Diagrams Showing the Optical System for the Rotary Table, and Typical Settings of the Vertical and Horizontal Scales

Factors Affecting Performance in Cylindrical Grinding

By J. A. MUELLER*

In any grinding operation, the results obtained depend on the characteristics of the abrasive wheel, the speed and feed, the condition and capacity of the machine, and the grinding fluid. The performance of an abrasive wheel varies considerably, depending on the speeds and feeds at which it is operated. For cylindrical grinding, the basic operating factors are: traverse speed, work surface speed, width of cut—the distance the table advances for each revolution of the work—amount of in-feed, and the distance that the wheel is permitted to run off the workpiece at the end of each grinding traverse.

* Carborundum Co., Niagara Falls, U.S.A.

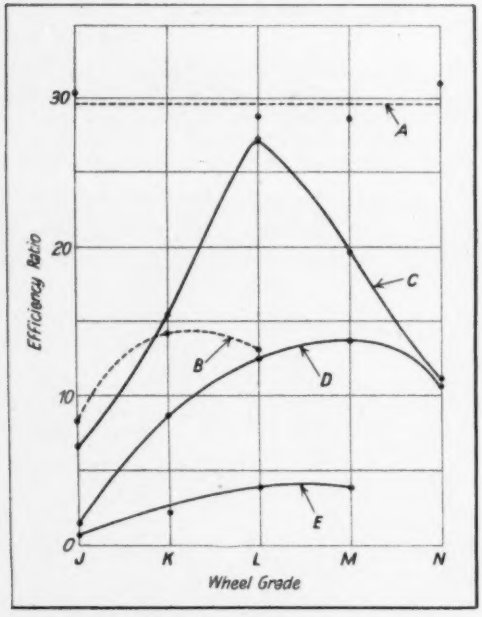


Fig. 1. Increases in Traverse Speeds Result in Lower Grinding Efficiencies, and Wheels of Harder Grades must be Used to Obtain the Best Results. *A*—35 ft. per min. surface speed, 29 in. per min., Traverse Speed. *B*—35 ft. per min. and 61 in. per min. *C*—70 ft. per min. and 29 in. per min. *D*—70 ft. per min. and 61 in. per min. *E*—70 ft. per min. and 120 in. per min.

SPEED AND FEED CONSIDERATIONS

Traverse speed of the table determines the production rate. The faster a workpiece passes across the face of the wheel, the more metal is removed in any given time. The effect on wheel performance when the traverse speed is changed is shown in Fig. 1. These curves show the grinding efficiency—the volume of metal removed divided by the volume of wheel loss for a range of wheel grades. The graphs relate to work speeds of 35 and 70 surface ft. per min. Two speeds have been included merely to indicate that the effect of a change in traverse speed is fundamental, and is not limited to a specific set of grinding conditions. All the curves in Fig. 1, 2, 3 and 4 are for aluminium-oxide wheels made from No. 465 grain-size abrasive with a vitrified bond. Steel ground in these tests was SAE 4142, hardened to 41 Rockwell C. The grinding fluid was an oil-water emulsion.

In general, Fig. 1 indicates that an increase in traverse speed results in lower grinding efficiencies. Higher table speeds break the wheel down faster. It also shows that the choice of wheel grade is less critical at slow table and work speeds. In everyday grinding, a variety of operations can be performed with one wheel, provided the table speed is sufficiently slow. Advantage can be taken of this fact in jobbing shops where a variety of short-run work is undertaken. In such shops, the majority of the work can probably be done with a general-purpose wheel, the table speed being adjusted to suit the job.

When the table speed is too high, wheels of different grades tend to break down to the same extent. As the traverse speed is raised, moreover, abrasive cost is also increased. It will be evident from Fig. 1 that there is a wheel grade which provides optimum grinding efficiency for each traverse speed. As the traverse speed is increased, a harder grade of wheel must be used to obtain this efficiency. The more rapidly a wheel breaks

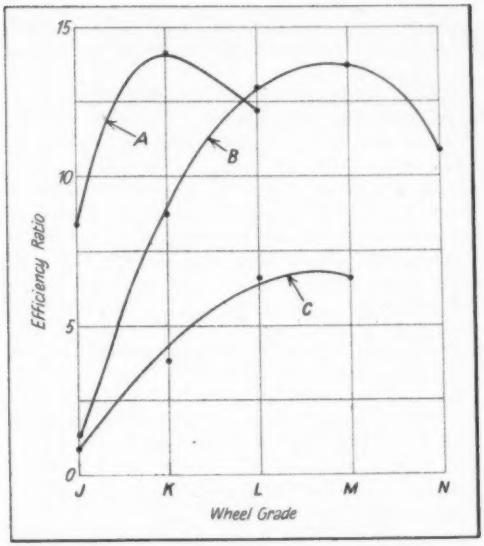


Fig. 2. The Curves Relate to a Metal-removal Rate of 0·56 cu. in. per min. Like Higher Table Speeds, Higher Work Speeds Cause the Wheel to Break Down More Rapidly and Harder Grades Must be Used for Optimum Grinding Efficiency. *A*—Work Speed 35 Surface ft. per min. *B*—70 ft. per min. C—150 ft. per min.

down, the more difficult it is to maintain work size and finish. It will thus be apparent that traverse speed substantially determines grinding wheel performance.

Work speed, unlike traverse speed, does not directly affect the metal removal rate. Grinding efficiencies for three different work speeds are shown in Fig. 2. In each case, the metal-removal rate was the same, and work speed was the only factor varied. It is evident from the curves that with an increase in work speed, grinding efficiency is lowered and, in general, the effects are similar to those resulting from an increase in table speed. Higher work speeds break the wheel down more quickly, and necessitate the use of harder-grade wheels for optimum grinding efficiency.

The width of cut taken by the wheel has an important effect on work finish. Obviously, the width of cut, which represents the advance per revolution, will be increased by an increase in traverse speed or a decrease in work speed, and vice versa. To measure the width of cut, a pencil may be held against the rotating and traversing work, with the hand steadied on the wheel guard. A scale may then be used to measure the advance per revolution. By this method, the cut can quickly be adjusted to the desired amount.

To obtain a good finish, a narrow cut should be taken, and for this purpose the traverse speed should be reduced and the work speed increased.

When the width of cut is decreased, a larger area of the wheel is available for cleaning up, and a finer finish is obtained. Finish-grinding is, of course, generally performed with light in-feeds, so that the wheel is not stressed to any great extent, and the slower traverse speed also results in a reduced rate of breakdown.

WITH INSUFFICIENT SPINDLE POWER GRINDING COSTS ARE INCREASED

The amount of power available at the spindle is important because it controls the production rate and affects the choice of the abrasive wheel. If there is insufficient power, only the softer grades of grinding wheels can be used. Grinding efficiency is thus reduced, and the operation becomes more costly than it need be.

Power requirements for wheels of different

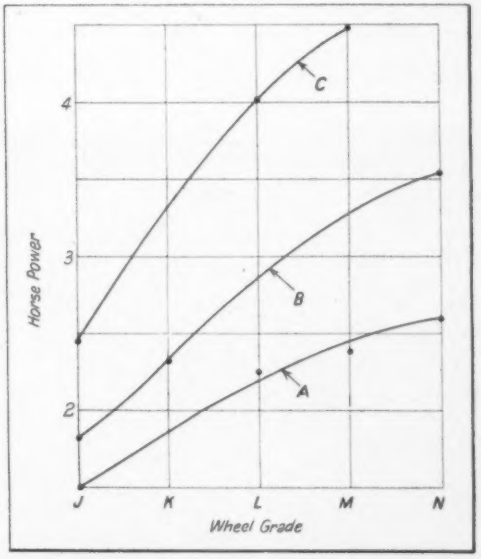


Fig. 3. A Harder Wheel Requires More Power than One of Softer Grade to Remove Metal at the Same Rate. If Insufficient Power is Available the Choice is Limited to the Softer Wheels. *A*—Metal Removal Rate, 0·28 cu. in. per min. *B*—0·56 cu. in. per min. C—2·12 cu. in. per min.

grades when removing metal at various rates are shown in Fig. 3. These curves clearly indicate that a harder wheel requires more power than one of a softer grade when removing metal at the same rate.

To supplement the information given by Fig. 3, the power required for various grades of wheels at different traverse and work speeds is shown in Fig. 4. Obviously, when operating at a faster traverse speed more power is required because metal is being removed at a faster rate.

When cylindrical grinding is carried out with in-feed at both ends of the work, a form is generated on the wheel face which is low at both edges and high in the centre. If, however, the wheel is allowed to run off the work by only a small amount, the in-feed becomes virtually a plunge cut. This plunge cut is made with a wheel face on which a high-centre low-edges contour has been generated. The effects of this procedure are as follows: the high portion of the wheel face grinds deeper than the low portions and the dimensional accuracy of the work cannot be maintained, and, at the same time, the favourable contour on the wheel face tends to be destroyed. Run-off should therefore be such that the wheel overlaps the work by only the width of cut at the end of each traverse.

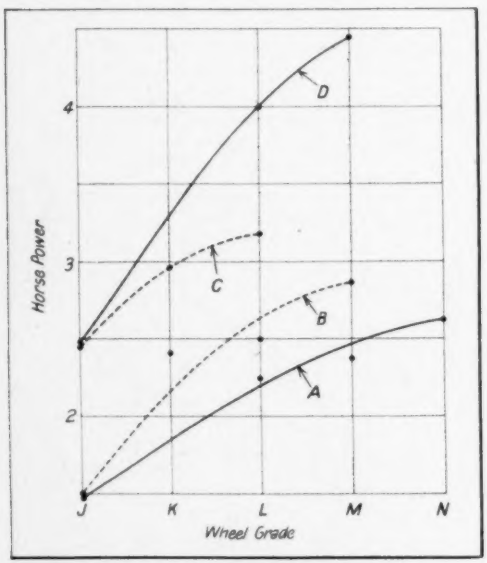


Fig. 4. More Power is Required for the Same Depth of Cut when the Traverse Speed is Raised, Since the Metal-removal Rate is Also Increased. *A*—Surface Speed 70 ft. per min., Traverse Rate 29 in. per min. *B*—35 ft. per min. and 29 in. per min. *C*—35 ft. per min. and 61 in. per min. *D*—70 ft. per min. and 120 in. per min.

Machine condition has an important influence on the performance of the wheel. Spindle bearings, machine foundations, guideways, and vibrations produced by adjacent machines, all influence the quality of the work surface. In general, vibration causes a wheel to break down more rapidly, so that it is more difficult to obtain size and finish. Consequently, where vibration is present, a harder-grade wheel is necessary for satisfactory operation. As has been shown, however, such a wheel requires more power. Any worn part may cause vibration, and it is important that machines should be kept in good condition throughout.

The grinding fluid serves to maintain the work at a uniform temperature, to lubricate the points of contact between the wheel and the work, and to remove the swarf from the grinding area. It also facilitates the production of a smooth finish. A copious supply of fluid is required at all times. Water-soluble oils in high concentrations tend to ensure better finishes, whereas detergent type fluids tend to maintain a clean wheel face and enable the wheel to produce the results normally expected of its grit and grade. Where extremely fine finishes are required, it may be necessary to filter the grinding fluid. Odour, ease of mixing, stability of emulsion, and rust-inhibiting properties are among the characteristics that should be considered in selecting a grinding fluid.

TUNGSTEN ARC CUTTING of metals was referred to by Mr. G. Sims-Davies, M.I.Mech.E., in a paper read at the recent Conference on Technology of Engineering Manufacture. Power is taken from a rectifier set, capable of delivering 40 amp. at an arc voltage of 100, and is fed to a torch, which embodies a shrouded electrode, surrounded by an inert gas. When the arc is initiated, the very rapid rise in temperature melts the metal beneath the electrode, and by moving the torch, a cut is made.

This method can be advantageously applied to the cutting of aluminium, and results comparable to the oxy-acetylene cutting of steel can be obtained, at phenomenonally high rates. Aluminium plate, ¼-in. thick, can be cut at a rate of 225 in. per min., for example, and plate up to 1½ in. thick can be cut by this technique.

It is stated that the process can be effectively applied to copper, brass and stainless steel plate, and has great possibilities for the production of complex shapes and apertures, since it is suitable for use in association with tape control systems.

Efficient Use of Wickman Multi-spindle Automatics on Medium Batch Production

Pollard Bearings Ltd., Ferrybridge, Knottingley, Yorks, make a very wide range of ball and roller bearings, from the largest types used in steel rolling mills, to the smaller sizes which are extensively employed in motor-cars, for example. A comprehensive range of plummer blocks, cartridge units, and flange bearings of widely different sizes, is also included in the firm's production programme, and the total output is progressively increasing. A very large number of individual bearing components is thus required, and despite the regular installation of additional new machine tools, double-shift working has been in force for the past eight years.

Because of the variety of types and sizes of bearings that is called for, the largest batch quantity is generally not more than 100,000, and the smallest may be only 100. Particular attention has therefore been paid to the establishment of a manufacturing procedure which ensures efficiency whatever the size of the batch. In connection with components such as inner and outer bearing rings, effective and increasing use is now being made of Wickman multi-spindle automatics, with the quick-change stroke-setting mechanism for the tool slides, whereby setting-up time is appreciably reduced. This feature, in conjunction with the use of pre-set, interchangeable tooling, and carefully-planned machine loading, permits batches as small as 100 pieces to be produced efficiently, whereas previously the use of an automatic was not considered to be economical for such small numbers. A view of the automatic shop at the works of Pollard Bearings Ltd., as at present arranged, is given in Fig. 1.

An important feature of the system of machine loading, which contributes materially to the reduction of setting-up times, is that one batch of parts, made on a particular machine, is followed, as far as possible, by a batch of a similar type. The sequence of machine loading is generally determined three or four months in advance, and it may be noted that the principle of producing similar parts is not carried to the point where a machine would be kept idle while others were overloaded, since no change-over takes more than about ten hours, and some require less than four hours.

Another factor which helps to reduce change-over times is the provision of two setters to each group of five machines. This proportion is higher than in many factories, but is found essential for maintaining production when there may be as many as fifteen changes per week in one group.

The design of all tooling layouts, also tool design, is undertaken by Pollard Bearings, Ltd., and as a further contribution towards maintaining output, the tooling is kept as simple as possible. Anti-friction bearing production calls for few unusual tool arrangements, and the only independently-fed

Fig. 1. A General View of the Automatic Shop at the Works of Pollard Bearings, Ltd.

attachments used are standard recessing slides, and a special marking roll attachment of Pollard design, which eliminates the need for a separate marking operation. This attachment, seen at *A* in the close-up view, Fig. 2, mounted on a bridge over the cross-slide, is operated by the slide motion.

All the tooling is of high-speed steel, and En.31 steel bar and tube stock is used throughout, so that a uniform cutting speed can be employed, which simplifies selection of the correct spindle speed. Tolerances are specified to allow for the grinding operations which normally follow, and the great majority of the parts must be within limits of ±0·002 in. In the Pollard range of Self-Lube bearings, it may be noted, a small undercut is required to take a sealing plate, and here a tolerance of 0·002 in. must be maintained.

The inspection system employed in the automatic shop is simple and adaptable. A set of gauges, designed for speed and ease of application, is provided at each machine for use by the setter, also by a patrol inspector, and the need for transporting the work to a separate inspection department at this stage of manufacture is thus obviated. A typical set of gauges is seen in Fig. 3.

It is of interest to note that more than half the labour force has been trained by the company, within the factory, and the methods of utilizing multi-spindle automatics on medium and small batch production have been so successful that they are to be applied in two subsidiary factories which are being established, one in this country and another in Canada. Plans are also being made to expand the main factory, which will require the installation of additional Wickman automatics.

Fig. 2. A Roller Marking Attachment *A* is Here Seen on a Wickman Multi-spindle Automatic

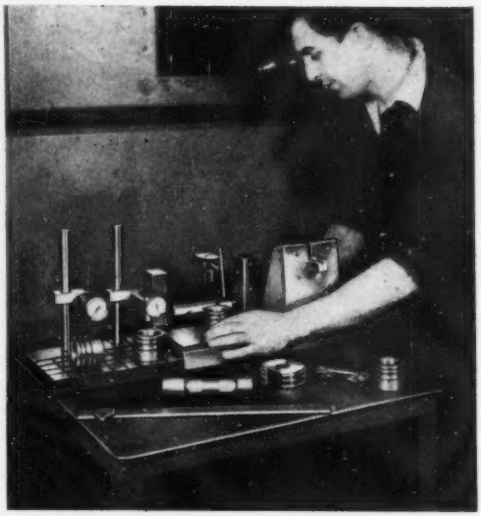


Fig. 3. A Typical Set of Gauges for Inspecting Bearing Races

AN ANTI-SKID DEVICE for high-powered cars and commercial vehicles has been developed by the Dunlop company, based on their Maxaret anti-skid units for aircraft. A small flywheel in each unit is driven from the braked wheel, and is slowed down by a spring as the wheel is decelerated. If deceleration is normal, there is no tendency to skid, and energy given up by the flywheel is not sufficient to collapse the spring, so that the unit is inoperative. If wheel deceleration is very rapid, thus tending to cause skidding, the spring collapses, and a small hydraulic valve is actuated to relieve brake pressure, until the flywheel returns to its normal setting, as the wheel regains non-skid speed.

Tests carried out with a high-powered car, under widely differing conditions and at speeds up to 95 m.p.h., have shown that the units enable the driver to maintain maximum deceleration, while having complete directional control of the vehicle. Moreover, the use of the units results in much greater braking power being available than normal.

New Production Equipment

Newall No. 1520 Jig Borer

The Newall Engineering Co., Ltd., Old Fletton, Peterborough, have recently extended their range of jig borers to include the No. 1520 machine shown in the figure.

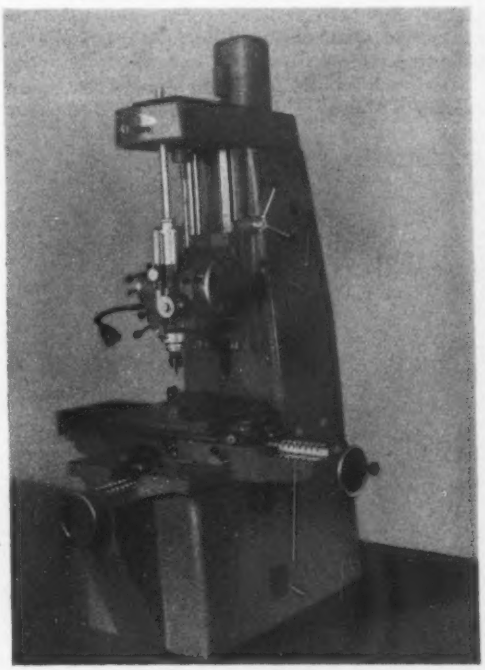
Co-ordinate settings of the 15- by 20-in. T-slotted work table are made to an accuracy of 0·0001 in. by Microlocator units in conjunction with 1-in. diameter rollers of hardened steel, chromium plated and lapped, which are accommodated in precision ground channels between the flat and inverted vee guideways. Table movements of 15½ in. longitudinally and 10½ in. transversely are provided. Slideway clamps, also wipers and bellows-type guards are fitted, and when settings have been made, the handwheels can be pushed out of engagement with the traversing screws to prevent accidental movement of the table.

The spindle head has a capacity for drilling holes up to ¾ in. diameter from the solid in mild steel, and can be adjusted through a maximum distance of 12 in. on the column ways by a capstan-type handwheel. Operation of this handwheel automatically releases and engages the spindle head clamps. A maximum distance of 20 in. is obtainable between the spindle nose and the working surface of the table. The distance between the centre line of the spindle and the column ways is 12 in.

Drive is taken from a 3-speed motor of 1½-¾ h.p. through a built-in gearbox, and 12 spindle speeds, ranging from 67 to 3,000 r.p.m., are obtainable, selection being made by means of a conveniently-placed lever. Operation of the "stop" push button causes an electro-magnetic brake to be applied for quickly stopping the spindle, and holding it firmly while cutting tools are being changed. Provision is made for rotating the spindle freely by hand to facilitate setting work with the aid of a dial indicator. The spindle quill has an axial travel of 5 in., and three power feeds, namely 0·0015, 0·003 and 0·006 in. per rev. are available in both directions. Coarse and fine adjustments of the quill are made by separate handwheels. The feed gears are splash lubricated, and there is a built-in pump for automatically lubricating the spindle drive gearing.

Mounted in pre-loaded precision taper roller bearings at the nose end and a dual-purpose ball bearing at the upper end, the spindle has a bore of 12½ deg. taper angle, and is usually fitted with a sleeve to take a No. 2 Morse taper shank. Alternatively, sleeves for accommodating shanks with different tapers can be provided.

The machine weighs approximately 2 tons and occupies a space of 58 by 68 in. It is intended to be mounted on three floor plates and levelled by screws in the base, so that the need for grouting-in is avoided.



Newall No. 1520 Jig Borer

Wickman-Moulton Universal Thread Milling Machine

Shown in Fig. 1 is the Wickman-Moulton universal thread milling machine introduced by Wickman, Ltd., Coventry. Of the same robust construction as the well-established Wickman-Moulton short thread milling machine, this new design has a capacity for cutting internal and external threads up to 5 in. diameter, and workpieces up to 20 in. long are admitted between centres. Greater length capacity, in increments of 10 in., can be provided if required.

A range of 22 standard change gears is provided, which enables threads from 32 per inch up to 12-in. pitch to be cut, and gears for metric pitches can be supplied. The cutter head, seen in the close-up view, Fig. 2, is so designed that, in addition to threads, straight splines can be milled singly, and conventional or climb milling can be performed.

Standard index plates for the workhead permit threads with multiple starts, up to 24, in seven steps, to be cut, and index plates for other numbers of starts can be supplied. For short thread milling, where the full length of thread is cut in slightly more than one revolution of the workpiece, provision is made on the spindle for mounting multiple ring-type cutters.

The work spindle and cutter spindle can be run independently in either direction, and standard pick-off gears give a range of 15 speeds, from ¼ to 4 r.p.m. for the work spindle, and five speeds from 212 to as high as 850 r.p.m. for the cutter spindle. A fast traverse motion for the cutter saddle is provided by a separate motor, which is electrically interlocked with the feed drive, and trip switches are fitted for stopping the machine at the completion of the cutting cycle. An attachment is available for taper thread cutting.

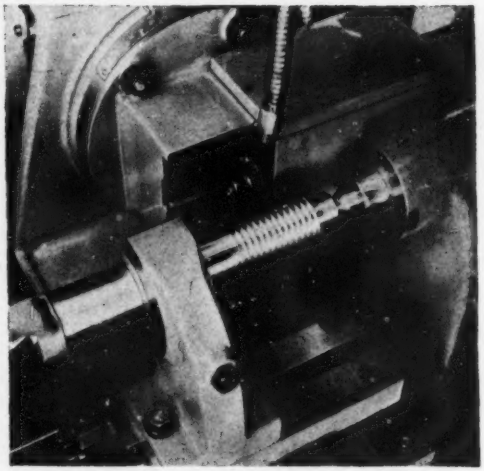


Fig. 2. Close-up View of the Cutter Head on the Wickman-Moulton Thread Milling Machine

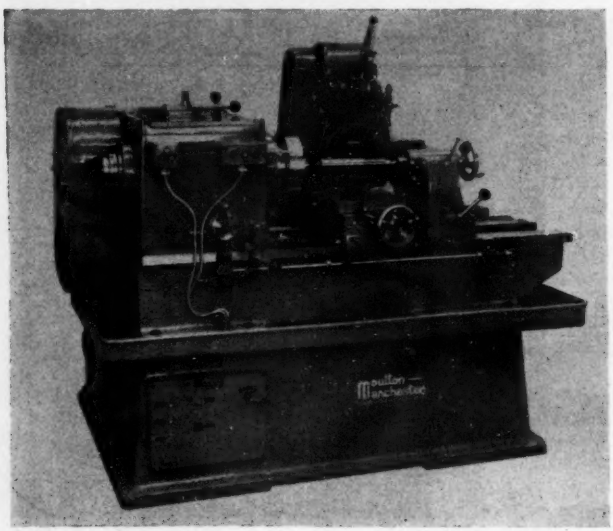
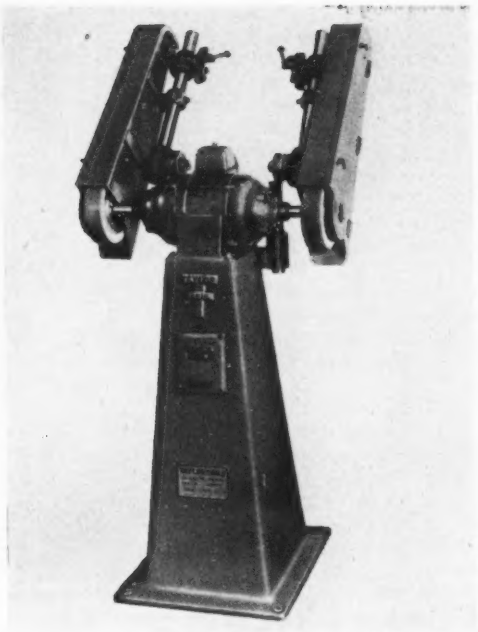


Fig. 1. Wickman-Moulton Universal Thread Milling Machine

Taylor 8-in. Vertical Backstand Grinding and Polishing Machine

The accompanying illustration shows the 8-in. vertical backstand grinding and polishing machine built by Taylor Tools & Supplies, Ltd., Broadheath, Altrincham, Cheshire. It is designed for operations on small or medium-sized components and can be used with a contact wheel up to 8 in. diameter or for free strapping. The machine can be supplied in the form shown, with two arms, with one arm and a polishing mop at the opposite end, or with one arm and a grinding band arranged for finishing flat surfaces.

The sensitive tensioning and tracking arrangements enable narrowest



Taylor 8-in. Vertical Backstand Grinding and Polishing Machine

abrasive belts to be used without risk of breakage, and the maximum belt width is 2 in. The arms are adjustable for angle, from 80 deg. to horizontal, and belts of various lengths from 60 to 66 in. can be fitted. To accommodate belts of different lengths, the tension pulley is moved along the arm, and the final tensioning is effected by means of a screw, which serves to adjust the load exerted by a spring.

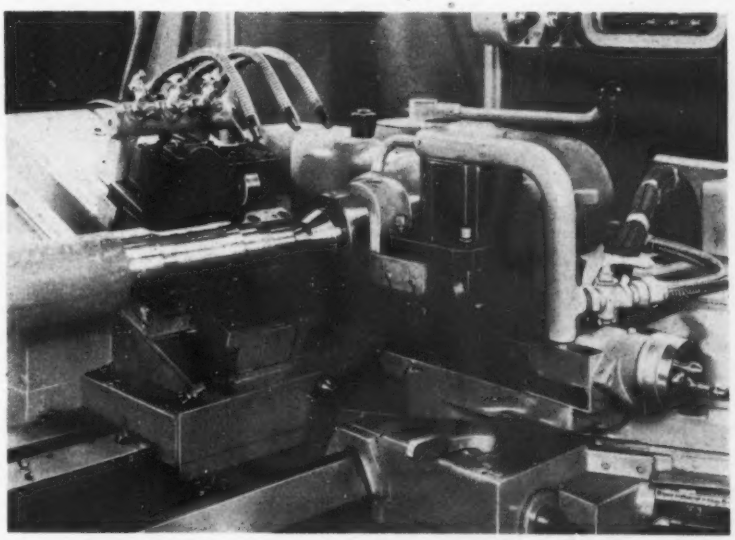
A 1-h.p. motor is provided for light duty, and a 2-h.p. motor for heavier work, and for each the spindle speed is 2,850 r.p.m. The rotor, which is dynamically balanced, is mounted directly on the grinding wheel spindle, and the end shields are extended to afford support for the spindle ends, and provide dust-proof enclosure. Of high-tensile steel, the spindle runs in heavy-duty ball bearings.

The approximate distance between the contact wheels is 24 in., and the height from the floor to the spindle centre is 42 in. Standard belt guards are fitted, and dust collectors can be supplied. The approximate weight of the machine is 280 lb.

Monarch Hydraulically-operated 2-position Lathe Turret

Introduced by The Monarch Machine Tool Co., Sidney, Ohio, U.S.A., the 2-position, automatic, hydraulically-operated, turret shown in the figure is designed to take two 1 in. by 1½ in. tools, and to index through 180 deg. in either direction, to a positive stop. This turret is intended for use on the type 21 Mona-Matic lathe, and indexing is initiated, at the required point, by the multi-cycle programme control system. Positive locking in the operating positions is ensured by a combined mechanical and hydraulic arrangement.

Normally, the turret is indexed just before the last cutting cycle begins, so that one tool is used for finishing only. An "on-off" switch is provided, so that, when indexing is not required, the turret will remain locked in one position. Hydraulic



Hydraulically-operated 2-position Turret for the Monarch Type 21 Mona-Matic Lathe

pressure for turret operation is supplied by the normal oil-supply circuit of the Mono-Matic lathe.

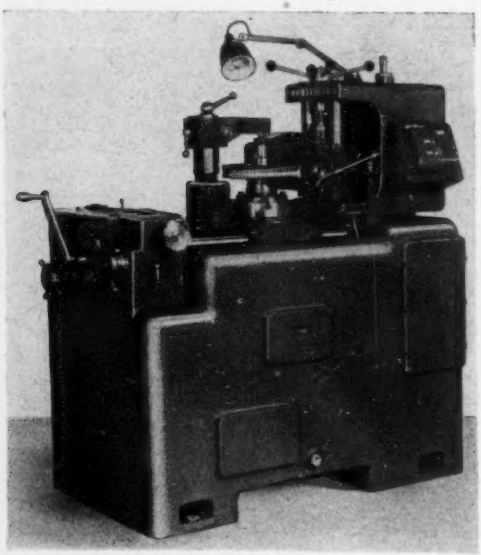
The Monarch Machine Tool Co. are represented in this country by Rockwell Machine Tool Co., Ltd., Welsh Harp, Edgware Road, London, N.W.2.

Dronsfield's 12-in. Worm Wheel Hobbing Machine

Dronsfield Brothers, Ltd., Oldham, Lancs., have recently built the No. 505 hobbing machine, here illustrated, for cutting worm wheels up to 12 in. diameter. Of simple design, it is claimed to combine high productivity with adaptability for economical operation in works where a variety of worm gears is required in limited quantities. The maximum centre distance between the hob and the work is 8 in., and the maximum hob dimensions are 3½ in. diameter by 4 in. long.

Of ribbed design, the main frame houses the 2-h.p. driving motor, coolant pump and electrical equipment. All the controls are grouped at the front and all parts of the machine are readily accessible. A detachable cover facilitates the removal of swarf from the bed.

Carried on rigid support pillars, the cutter head has central, vertical, adjustment for aligning the hob to the work. On the standard machine, a non-swivel head is fitted, and a swivel-type can be supplied, if required. The hob spindle is bored to receive No. 4 Morse taper shank arbors. Of integral construction, the work spindle and 9-in. diameter table run in taper-bored; double-row, cylindrical roller bearings, and thrust is taken on a pair of double-purpose ball bearings. T-slots are provided in the table for carrying work fixtures, and it is bored 2¼ in. diameter. The work spindle carriage is mounted and slides on two horizontal ground steel tubes, which give support close to the work, and provision is made for taking up wear.



Dronsfield's 12-in. Worm Wheel Hobbing Machine

Work is fed by hand until contact is made with the hob, and the feed then continues to the required depth, whereupon it is automatically disengaged. A red warning light is illuminated at the completion of the cut. Provision is made for varying the rate of feed according to the material being cut.

The motor is mounted on an adjustable platform for the belt tensioning, and a self-contained gearbox provides the drive to both the hob spindle and the work table, through worm-reduction and helical gears. All shafts are mounted in ball or roller bearings, and the gears are spray lubricated from a centrifugal pump. Hob speeds of 48, 67, 90 and 160 r.p.m. are obtained by means of pick-off gears.

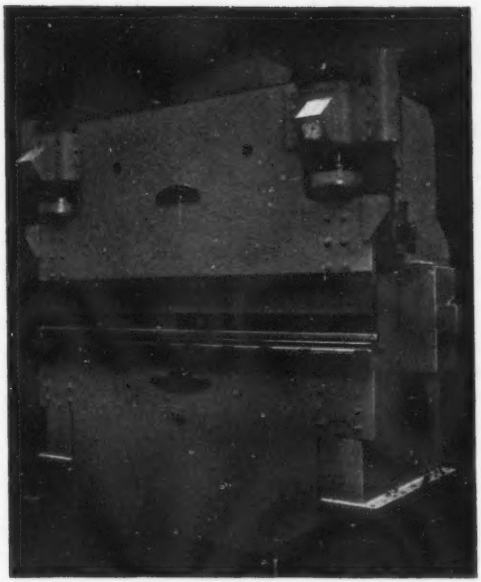
An overarm stay is mounted on the work spindle carriage for use when cutting gears of the larger pitches. The support arm can be swung clear to facilitate loading, and vertical adjustment is provided by means of rack and pinion. Change wheels are supplied for cutting worm wheels with numbers of teeth from 10 to 100.

The overall dimensions of the machine are 6 ft. long, 3 ft. wide and 5 ft. high, and the approximate weight is 30 cwt.

Craig & Donald 400-ton All-steel Hydraulic Press Brake

The 400-ton, all-steel, hydraulic press brake, shown in the figure, has recently been built at the Craig & Donald works of the Scottish Machine Tool Corporation, Ltd., 17, Lynedoch Crescent, Glasgow. Plates up to 10 ft. wide are admitted between the standards, and the overall die length is 14 ft.

With the pressure cylinders acting directly on the main slide, there is no backlash in the system to be taken up when the tools contact the work. Pressure can be applied at any stage of the stroke, and it may be continued throughout the entire stroke if necessary, and sustained at the bottom of the stroke for as long as is required. A special compensating control ensures that the slide remains



Craig & Donald 400-ton, All-steel, Hydraulic Press Brake

parallel to the bed even when the resistance is at one end only.

Two limit switches, which can be adjusted to suit the work, control the length of stroke, and the latter may range from zero to a maximum of 9 in. The shorter strokes, it may be noted, can be applied over any portion of the complete 9-in. range. For each operation, the limit switches are set as close together as the work permits, so that the cycle time is reduced to a minimum.

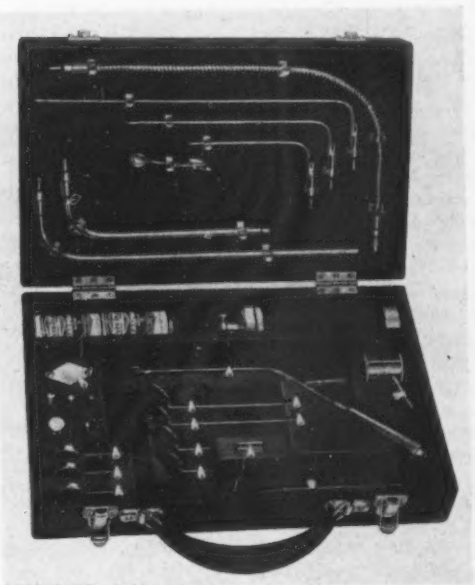
The hydraulic system provides a rapid approach and withdrawal speed and a slower pressing speed which comes into operation automatically when resistance is encountered. With this arrangement, work handling is made easier and safer, particularly when operations are being carried out on heavy plates or large sheets are being flanged. A second blow can readily be struck, if necessary. If the maximum permitted pressure is exceeded, the slide will either stop or return to the upper position, depending on the control cycle employed.

Various cycles are available, and with each, the slide can be returned to the upper position at any stage by depressing a push-button. These cycles are as follows: automatic one-stroke with reversing position pre-set; automatic one-stroke with reversing pressure pre-set; continuous with reversing position pre-set; continuous with reversing pressure pre-set; controlled with "stop" position pre-set; and controlled with "stop" pressure pre-set. For the two latter cycles, the pedal is depressed and held down, and the slide descends and stops at the pre-set position or pressure. It then dwells until the pedal is released, whereupon it returns to the upper position. When the pressure has been pre-set, it is maintained during the dwell. If the pedal is released before the oil pressure has reached the pre-set value, the slide changes direction, and if the pedal is again depressed, the downward motion is resumed, so that inching action can be obtained.

There is also a special inching control whereby the slide is caused to descend as long as the pedal is depressed, and to stop when the pedal is released. The required maximum working pressure can rapidly be set by a calibrated pressure switch.

Ellispection Visual Inspection Equipment

For viewing the interiors of castings, pipes, and machine assemblies, for example, Ellis Optical Co., Mayday Road, Thornton Heath, Surrey, have recently introduced the Ellispection visual inspection equipment, which is supplied in a hardwood case, as shown in the figure.

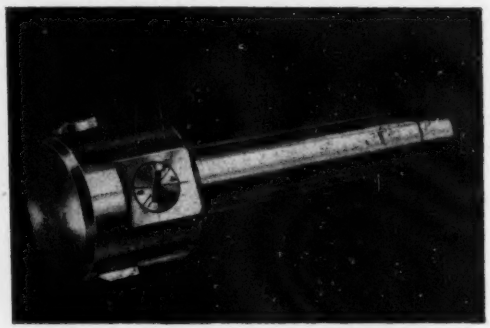


Ellispection Visual Inspection Equipment

Inspection is carried out with the aid of flexible and rigid probes, with fixed and adjustable mirrors and magnifiers. The probes range in size down to ⅛-in. diameter. Two torch-type batteries in the handle supply current to bulbs on the probes. Metal parts of the equipment are nickel plated.

Harris Patent Floating Expanding Reamer

In the accompanying figure is shown the Harris patent, floating, expanding reamer, which is being produced in a range of eight sizes, to cover holes



Harris Patent Floating Expanding Reamer

from 1 to 4½ in. diameter, by F. & T. Kitchin, Vickersdale Works, Stanningley, Pudsey, Yorks. Adjustable float in the reamer is unaffected by the setting for size of hole, and enables accurate results to be obtained irrespective of wear in a turret or boring bar holder.

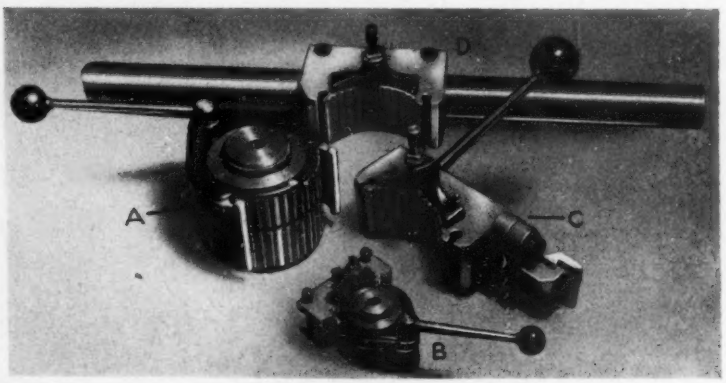
The solid body is of 45-ton tensile steel, and the two cutters are positively advanced or retracted by a robust worm, wormwheel and screws. Clear markings on the micrometer dial facilitate setting to limits of 0·0005 in. Either high-speed steel or cemented-carbide-tipped cutters can be provided, and they are well supported in the body. The cutters can readily be removed for grinding, or may be ground in position, using the body as a fixture. Special cutters can be supplied for reaming blind holes. Standard reamers have Morse taper shanks, ranging from No. 1 to No. 5. Reamers of this design can also be employed with boring bars.

Multifix Quick-change Tool-post

Hardinge Machine Tools, Ltd., Hampton Road West, Hanworth, Feltham, Middlesex, have recently been appointed sole agents in this country for the range of the Swiss-made Multifix quick-change tool-posts for centre lathes.

These tool-posts are available in three sizes, the largest and smallest of which are shown at *A* and *B* in the illustration. The smallest tool-post has a holder to take a square section turning tool, and at *C* and *D* are shown a screwcutting attachment and a holder for a boring bar, which are intended for use with the largest tool-post. Alternatively, the holder seen at *D* may be fitted with a bush to take twist drills with No. 3 and 4 Morse taper shanks. A feature of the attachment seen at *C* is that the tool-slide can be moved towards and away from the work by means of a ball-ended lever, so that the tool-bit can quickly be moved clear when screw threads are being cut close to a shoulder. The tool-bit is carried by a swivel end piece on the slide, which can be accurately adjusted to suit the helix angle of the thread to be cut.

Of case-hardened steel, the body and the various tool holders have precision-ground mating serrations, which ensure accurate location, and permit the holders to be indexed to 40 positions. The holders can be adjusted independently for height



Examples of Multifix Quick-change Tool-posts and Interchangeable Tool Holders

by means of screws, and they are secured by a swivel cam-operated band clamp, which partly surrounds the body and is engaged and released by movement of a ball-ended lever. Partly-cylindrical projections at the ends of the clamp engage with slots in the holders to apply gripping pressure. The body is secured to the tool slide of the lathe by a central bolt.

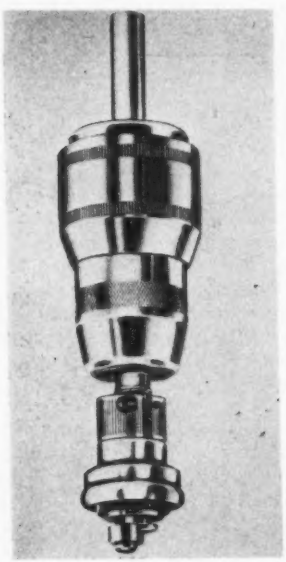
With this arrangement, a number of cutting tools, for performing various operations at a single setting of the work, can be pre-set in different holders, which can then be quickly mounted in position, as required. Another feature is that turning tools can be re-ground without the need for removing them from the holders.

Salter Truarc Internal Grooving Tool

Shown in the illustration is the Truarc internal grooving tool, which has recently been placed on the market by Geo. Salter & Co., Ltd., West Bromwich.

Intended primarily for cutting grooves for spring retaining rings, this tool may also be used for such operations as light-duty facing, and forming undercuts for internal screw threads. It is made in five sizes for cutting grooves in bores from ⅝ to 4 in. diameter.

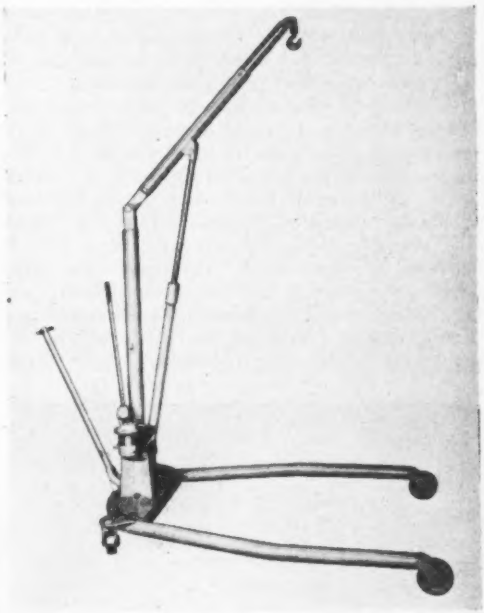
In operation, axial feed is applied to the tool until a flanged bush makes contact with the end of the work. Continued axial movement then causes the cutter to be traversed outwards, on an eccentric path, this travel being controlled by a built-in stop. The setting for groove diameter is obtained by means of an axially-extending screw at the shank end of the body, adjustments being made in conjunction with a micrometer. In addition, the distance between the cutter and the flange on the brush, which determines the position of the groove relative to the end face of the work, may be set with the aid of a slip gauge.



Salter Truarc Internal Grooving Tool

Epco Mobile Hydraulic Crane

Recently introduced by Epco, Ltd., Star Works, Leeds, 7, the mobile crane here shown, is made in two sizes, which will handle loads weighing from 2 to 5 and from 10 to 20 cwt.



Epco Mobile Hydraulic Crane

The length of the telescopic jib can be varied from 35¾ to 58 in., and when it is set in the fully-extended position, maximum and minimum distances of 110 and 13 in. are obtainable between the lifting hook and the shop floor. Pivoting of the jib for raising loads is effected by a hand-operated 2-stroke hydraulic pump, and the return speed is accurately controlled by a release valve.

If required, the jib and pump assembly can be removed fom the wheel-mounted tubular-steel base, and arranged to swivel in a socket set in the shop floor. The crane may then be used, for example, for loading and unloading of heavy work-pieces on machines. Alternatively, the crane may be mounted in a similar manner on a lorry to facilitate handling crates and other loads.

Flame-Hardeners Radio-frequency Hardening Machine for Starter Ring Teeth

Flame-Hardeners, Ltd., Bailey Lane, Sheffield, have recently developed the radio-frequency hardening machine for starter ring teeth, shown in Fig. 1, for use in their works. It is employed in conjunction with a Redifon 7 kVA., type IH.39 radio-frequency generator, and is arranged for electrically-controlled pneumatic operation.

At the beginning of the operation sequence, a copper inductor is placed over one tooth of the starter ring. The inductor is secured by two wing screws and may readily be changed to suit the work. It is shaped in accordance with the tooth profile to be treated, to provide for the "crash-end," variable depth, and taper.

When a micro-switch is tripped, the radio-frequency current is supplied to the inductor, and the heating period is automatically controlled by a timing device. This device also controls the quenching stage, the quenching head being integral with the inductor, and the indexing of the starter ring by means of an air-operated ram and ratchet, as shown in the close-up view at Fig. 2. The heating time is usually 2½ sec. per tooth, and the quenching time, 4 sec.

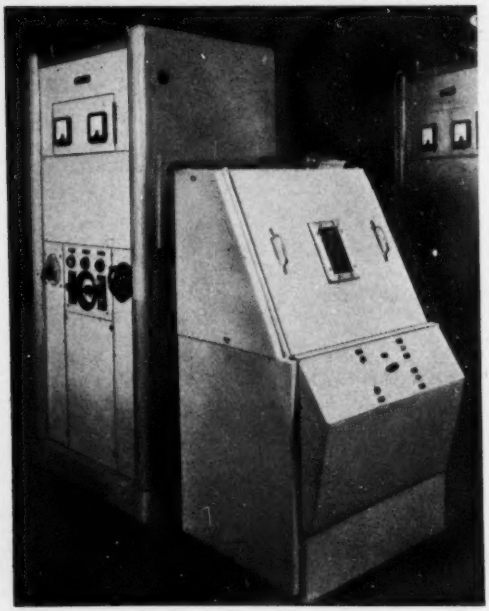


Fig. 1. Flame-Hardeners Radio-frequency Hardening Machine for Starter Ring Teeth

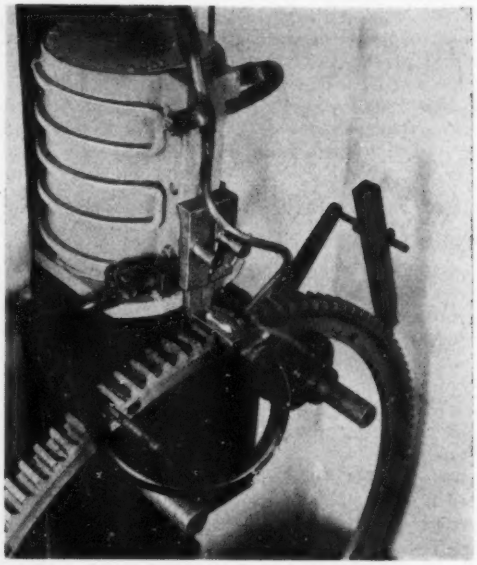


Fig. 2. Close-up View Showing a Starter Ring Set Up for Hardening

Before the operation is started, a Veeder-Root counter is set to the number of teeth on the ring, and when all the teeth have been hardened, this counter switches off the radio-frequency supply, and a two-note warning to the operator is sounded. The first note indicates that the last tooth is being treated, and the second denotes completion. During the interval, the operator can prepare a fresh workpiece for insertion, and re-set the tooth counter to zero, before removing the treated ring and reloading the machine. Starter rings up to 24 in. outside diameter can be processed.

The electrical controls, timing device, pneumatic equipment, and operating mechanism are contained in the fabricated steel cabinet, which also

houses the quenching fluid tank. Overall dimensions of the cabinet are 30 in. long, 24 in. from front to back, and 48 in. high. The timing equipment is mounted behind the front panel so that it is readily accessible.

It is stated that laboratory tests of treated rings have indicated that very satisfactory results are obtained. A soft tooth core is required with hardened flanks and "crash-end." Materials in the En.8 class are mainly used for this type of component, and the hardness normally specified is in the region of Rockwell 48 C.

Equipment for Centreless Grinding Outer Rings for Self-aligning Bearings

When outer rings for self-aligning ball or roller bearings, of the form indicated at *A* in view *X*, Fig. 1, are centreless ground by the plunge method, it is necessary to make provision for supporting them in a vertical position during the grinding operation.

Rings of this type are ground automatically on a Scrivener No. 2 controlled-cycle machine, equipped as shown in Fig. 2. The rings are loaded into a sloping magazine, and at the beginning of a grinding cycle, the lowest piece in the magazine falls into the path of a push-feed mechanism whereby it is advanced into the grinding throat. To provide the necessary support, the piece is

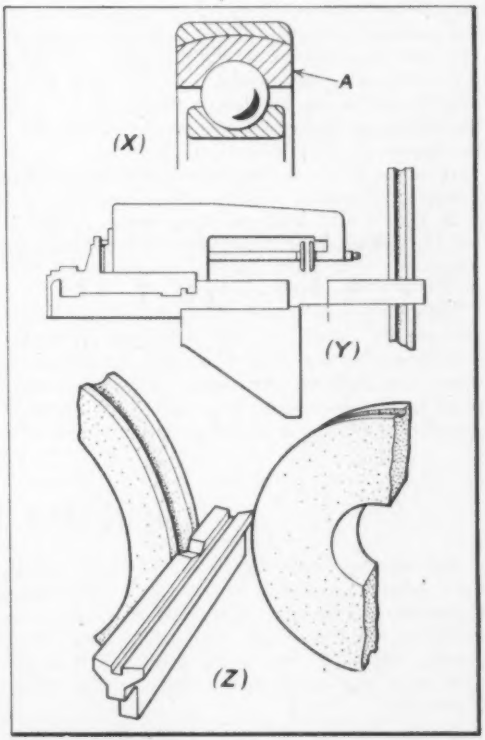


Fig. 1 (above). Self-aligning Bearing and Equipment for Centreless Grinding the Ring *A* which has a Spherical Outer Surface

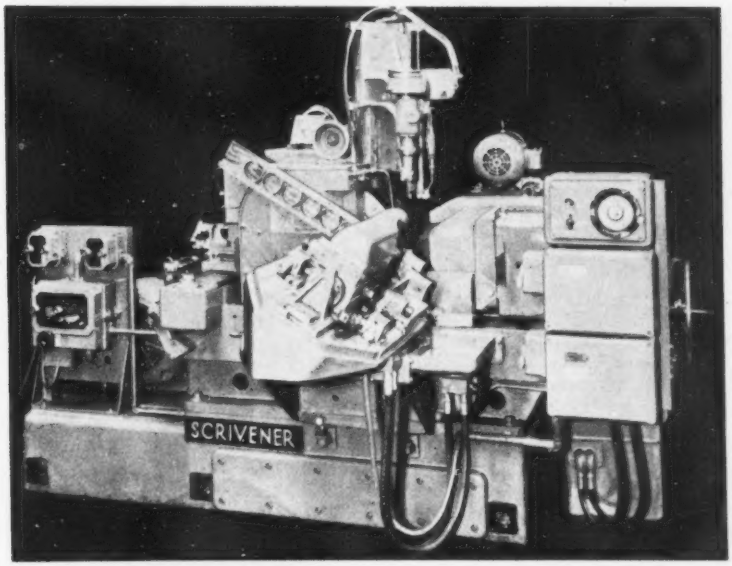


Fig. 2 (left). Scrivener No. 2 Controlled-cycle Centreless Machine Equipped for Plunge-grinding the Ring *A*, Fig. 1. Two Discs Keep the Ring in a Vertical Position During the Operation

gripped between two discs while it is advanced into the grinding position. These discs are seen in the view at Y in Fig. 1. With the piece resting on the work-plate, the pressure on the rear disc is relaxed sufficiently to permit free rotation under the action of the grinding and control wheels of the machine.

In place of the normal work-plate the machine is equipped with a V-plate of the type shown at Z in Fig. 1. In addition to providing a channel for the advance of the piece from the sloping magazine, this plate has a second vee which serves to locate it for grinding.

Both the grinding and control wheels are radius-dressed by means of the over-head hydraulic attachment seen in Fig. 1, all the movements of which are regulated by means of a Tele-control hand lever. Movement of a pointer to the right serves to lower the quill between the wheels or to raise it when the operation is finished, and movement of the pointer to the left causes the diamond quill to turn. With this arrangement either one or both wheels can be radius-dressed without breaking down or interfering with the set-up, apart from the slight adjustment of the wheels necessary to correct the setting. The radius is adjustable from ¾ in. to 3 in.

For dressing the peripheries of the wheels on both sides of the radiused portions, the standard hydraulic truing attachments are employed and the controlled-cycles mechanism is also of the company's standard design.

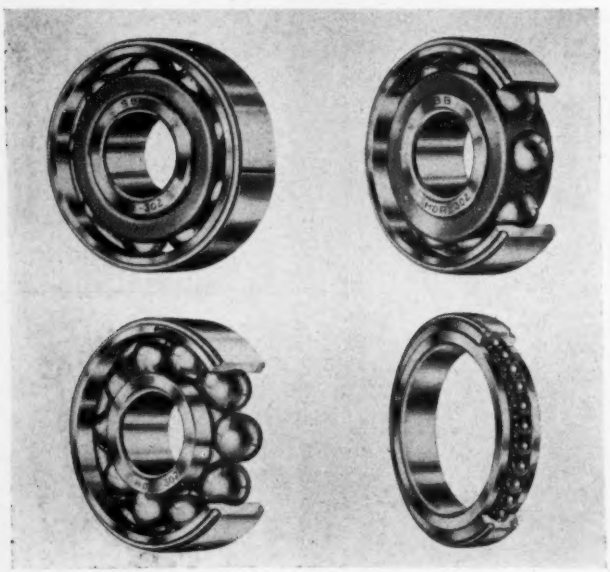
With a stock removal of 0·005 to 0·006 in., a ring of about 3½ in. diameter can generally be handled in two operations, each requiring approximately 15 sec. A net output of about 120 rings per hour can thus be obtained, roundness being held within 0·0003 in.

Split-race Ball Bearings

Ball bearings with outer races fractured axially have been introduced by the Split Ballbearing Corporation, Lebanon, N.H., U.S.A., and representative types are here illustrated. The design permits the outer race to be prised apart at the opening so that a full complement of balls can be introduced.

With this arrangement, a high radial load-carrying capacity is obtained, and since the need for a side-loading groove or a counterbored outer ring is obviated, a high thrust capacity is also ensured. In addition, ball retainers of one-piece construction can be employed. The fractured race is resilient and closes on the balls after loading has been completed. It is held in the closed position by circumferential wire rings at the sides. Where the crack surfaces meet, an effectively continuous race surface is obtained, and it is claimed that the fracture does not reduce the strength of the bearing.

The type TWF thin-section bearing, seen in the lower right-hand cutaway view, has races of a cross-sectional shape which provides integral side shields.



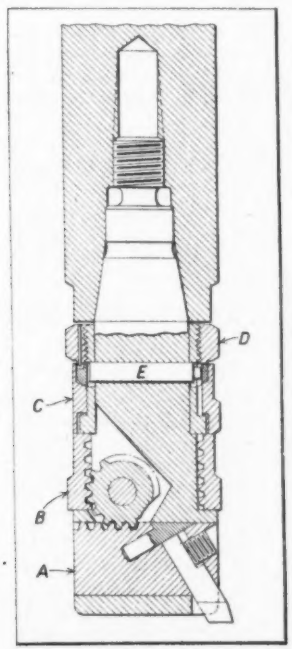
Examples of Split-race Ball Bearings. The Outer Race of Each Bearing is Fractured Axially, so that a Full Complement of Balls can be Introduced Without a Side-loading Groove or a Counterbored Outer Ring

Machine Shop Patents

A BORING-HEAD WITH A RADIALLY-ADJUSTABLE TOOL-HOLDER

The accompanying figure shows a sectional view of a boring-head in which the tool can be adjusted radially, without any axial movement. A tool-holder *A*, of circular or polygonal form, is free to slide axially within the body of the boring-head, and has rack teeth cut on its periphery. These teeth mesh with an idler gear, which meshes, in turn, with the internally-threaded bore of the sleeve *B*. This sleeve is free to rotate, but is restrained from moving axially. Rotation of the sleeve *B* will turn the pinion, which will, consequently, advance or retract the tool-holder *A*. A clamp is provided for locking the tool-holder in the required position.

The periphery of the sleeve *B* is graduated, and these divisions can be set in relation to a vernier scale engraved on the periphery of the sleeve *C*. This latter is restrained from rotating by means of a cross-pin *E*, in the body of the boring-head. The part *C* can be clamped by rotation of the ring *D*, axial movement being transmitted through an intermediate sleeve, which is free to move axially but is also restrained from rotation by the cross-pin *E*. Only 90 deg. of rotation of the ring *D* is required to clamp the sleeve *B*, and a pin in the former engages a slot in the intermediate sleeve, to limit this angular movement.

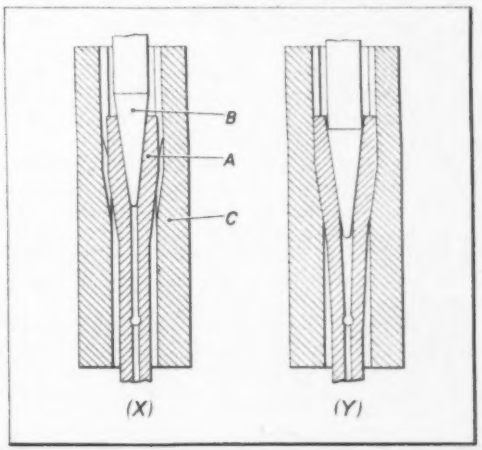


Sectional View of a Boring-head with a Radially Adjustable Tool-holder

787,380. Heinz Kaiser, Zurich, Switzerland. [*Application date, March* 18, 1956. *Published date, December* 4, 1957.]

A COLD-FORMING TOOL FOR SMALL-BORE TUBES

The views at *X* and *Y* in the accompanying drawing show a split mandrel *A* in the contracted and expanded positions, respectively. This mandrel has a cross-section which is equivalent to



A Cold-forming Tool, for Use in Small-diameter Bores, Shown in the Contracted and Expanded Positions

the form required in the bore of the workpiece *C*, and is opened and closed, at a high-frequency, by means of the pneumatically-operated reciprocating plunger *B*. The workpiece is fed longitudinally by a traversing saddle, and feed motion is applied only when the mandrel *A* is closed. Axial friction between the mandrel and the workpiece is thus avoided, and the cold-working is effected by percussion only.

If a rotary motion is applied to the workpiece, a helical form will be produced in the bore, as required for rifle barrels, for example.

788,418. Schweizerische Industrie-Gesellschaft, Rheinfall, Switzerland. [*Application date, December* 27, 1954. *Published January* 2, 1958.]

East German Tooth Broaching Machine for Large Spur Gears

A new approach to the problem of cutting teeth in very large spur gears, for example of more than 20 ft. diameter, has been made by VEB Zahnschneidmaschinenfabrik Modul, Karl-Marx-Stadt, East Germany, with the development of a broaching technique, whereby the teeth are cut, one at a time, by several passes of a horizontal, indexing broach.

A hydraulically-operated machine embodying this principle is stated to be nearing completion in East Germany, and a photograph of a model, which was displayed at the Leipzig Fair this year, is reproduced in Fig. 1. This impressive machine, which, it is reported, will weigh some 230 tons, will handle spur gears up to 23 ft. diameter by 27½ in. face width, with teeth of pitches as coarse as ½ D.P.

The indexing broach, with inserted tooth sections, cuts in both directions of travel, and a stroke of 12 ft. is provided by a hydraulic cylinder and piston, the steplessly-variable cutting speeds ranging from 20 in. to 50 ft. per min. A cutting force of 50 tons is available, and a total of 230 h.p. is required to drive the machine.

Fig. 2 shows the general arrangement of the machine, and the principle of operation is indicated by the diagrams in Fig. 3 and 4. Referring to Fig. 2, the workpiece, *A*, is carried on the spindle of a substantial headstock *B*, which incorporates indexing mechanism whereby any number of teeth up to 600 can be cut. The headstock is mounted on a saddle which can be traversed by power along bedways at right-angles to the direction of broach travel by means of a screw, for adjusting the depth of cut, traverse rates of 6 in. and ½ in. per min. being obtainable in both directions.

Scales are fitted to facilitate adjustment, and an inching push button is provided for the control of the traverse motor. Because of the heavy loads involved when handling a workpiece weighing, for example, 130 tons, a hydraulic pressure relief system is incorporated for the saddle guideways which is arranged to operate in two stages, and is said to ensure a smooth and sensitive movement. This relief system is interlocked with the traverse drive, so that it comes into operation before the saddle moves, and the saddle is automatically locked hydraulically, when the adjustment has been made. Hand adjustment is also available for the work-head saddle, which, for safety, is interlocked with the motor drive.

Two sizes of headstocks are provided, one for handling gears from 9 ft. to 13 ft., and the other for gears from 13 ft. to 23 ft. diameter. These headstocks, which incorporate large-diameter index wheels to ensure accurate tooth spacing on the work, can readily be interchanged after a drive shaft and plug-in electrical corrections have been uncoupled.

Provision is made in the drive for the headstock to permit of continuous rotation of the spindle at speeds up to 0·25 r.p.m., so that the mounting accuracy of the gear to be cut can be checked before the broaching operation is started. In addition, a planetary reduction gear is incorporated, whereby fine angular adjustment can be made to position a gear of the built-up type so that the joints

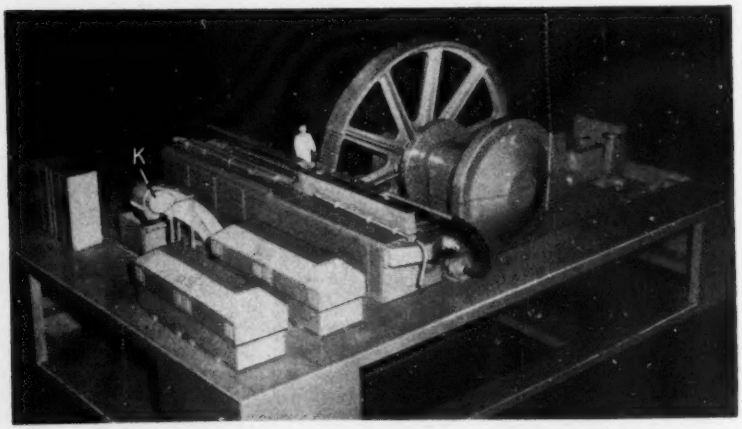


Fig. 1. This Model of the Large, Indexing Broaching Machine, for Cutting Spur Gears up to 23 ft. Diameter, was Exhibited at Leipzig

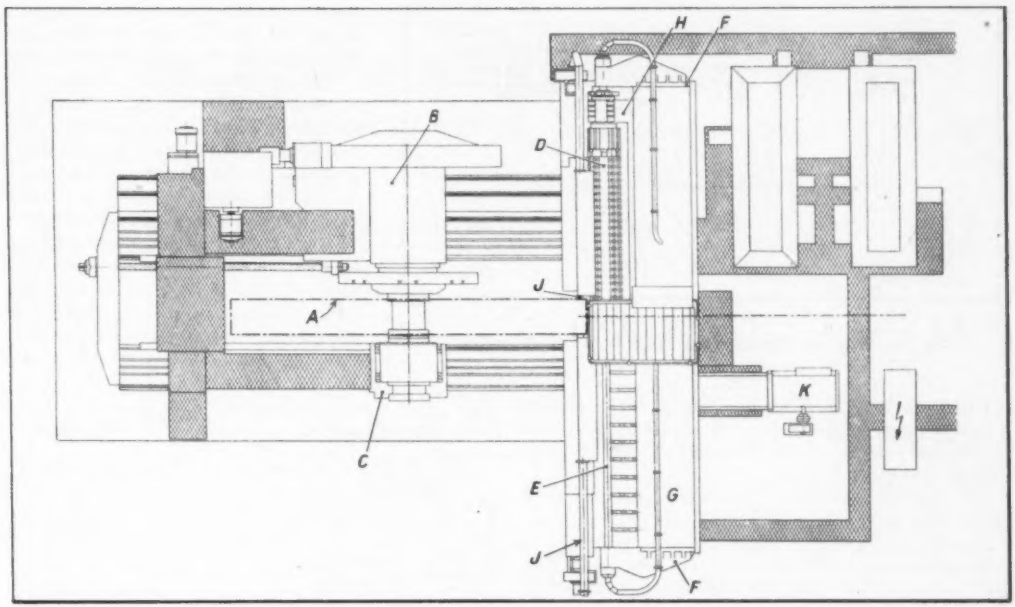


Fig. 2. The General Arrangement of the Spur Gear Broaching Machine

are located in tooth spaces. This fine angular adjustment also facilitates the setting up of gears which may require to be finish-cut at a second operation. To support the heavy loads, a hydrostatic oil lift system is incorporated for the spindle bearings of the headstock, and when dividing is being carried out during the machining cycle, a braking effect is applied to the rotating workpiece, by release of the hydraulic pressure, towards the end of the indexing movement.

On the opposite side of the saddle to the headstock, a support bearing *C* is provided for the outer end of the work arbor, and to facilitate the loading of heavy workpieces this support is arranged as a half bearing. A cradle is provided on the faceplate of the headstock spindle to locate the other end of the arbor, in preparation for coupling it to the spindle.

The indexing broach body *D*, is 6-sided, and the inserted teeth for the various stages of roughing and finishing are arranged in sections. This body member forms a hydraulic cylinder, and it moves over a piston carried on a rod *E*, Fig. 2, which is anchored at each end in brackets *F*, bolted to the base casting *G*. To permit of indexing, the broach body is mounted at each end in bearings which are incorporated in a substantial slide *H*, the latter being arranged to move in guideways on the vertical face of the bed casting. The broach body and slide assembly weighs some 17 tons, and because of the heavy bearing loads involved it is arranged to move on rollers in the guideways.

Indexing of the broach, and subsequent locking in the working position, is effected hydraulically.

During the broaching strokes, support against the cut is provided at each side of the gear-wheel rim by horizontal right- and left-hand hydraulic rams, as seen at *J* in Fig. 1, which are automatically retracted to allow the work to be indexed. The broaching cycle is controlled through solenoid valves and a hydraulic servo system, and is completely automatic, the machine being stopped when the required number of teeth has been broached in the workpiece.

A conveyor is provided for removing the considerable volume of swarf produced when cutting these large gears. This conveyor carries the swarf beneath the broach slide bed and lifts it to the discharge point *K*, seen also in Fig. 1, where it is delivered into a hopper. When broaching a gear of 20 ft. diameter by 23½ in. face width, and of

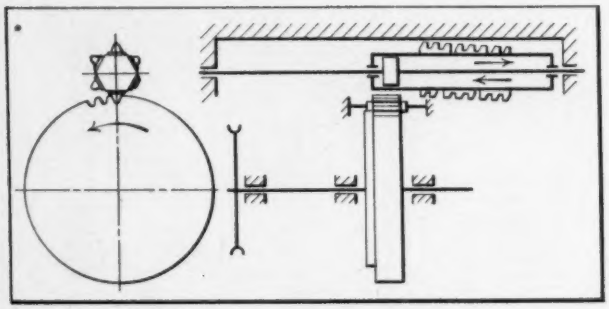


Fig. 3. Diagram Showing the Principle of the Machine

44 module (0·58 D.P.), for example, some 4½ tons of swarf are produced and it is stated that cuts producing chips of thicknesses up to 1 mm. (0·040 in.) can be taken.

Two variable-delivery hydraulic pumps, each with a maximum capacity of 70 gal. per min., are coupled to a 100-h.p. motor, and supply oil at pressures up to 1,200 lb. per sq. in., for traversing the broach slide. The rate of delivery, which is regulated electrically, can be varied by push buttons on the control console, and to ensure smooth acceleration and deceleration of the broach slide, the flow of oil from only one pump is initially admitted to the cylinder. Similarly, at the end of the stroke, the deliveries from the two pumps are cut off one after the other. The control arrangement is so designed that the required broaching speed can be accurately pre-set while the machine is at rest.

The diagrams in Fig. 4 show the sequence for broaching teeth of 20 module (1¼ D.P.). For this relatively fine pitch, only four of the six index positions on the broach need be used. At the first stage, the centre portion at the top of the tooth gap is removed, and at the second, the outer portions at the top are broached, leaving a small amount to be removed from the tooth flanks. The root portion is broached at the third index position, and the flanks are finished at the fourth.

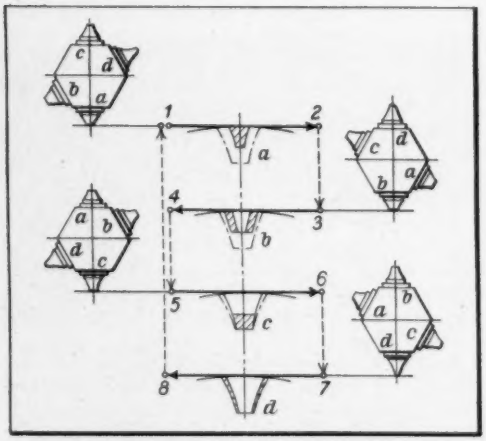
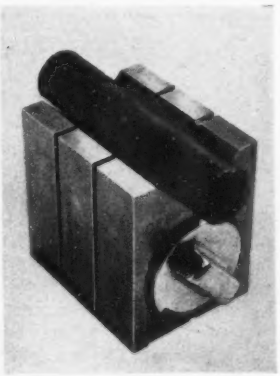


Fig. 4. Method of Broaching Teeth of the Finer Pitches, Using Four of the Six Sides of the Indexing Broach Holder

Microtest Magnetic Vee Block

The Microtest magnetic vee block, here shown, is marketed by William Urquhart, 1023-1027 Garratt Lane, London, S.W.17. It is intended for use in connection with drilling, marking out, and drilling operations on cylindrical parts, and is unaffected by coolants.



Microtest Magnetic Vee Block

Made from steel and case-hardened, the body incorporates permanent magnets which are brought into use, as required, by a rotary switch. By setting the switch to the "on" position a cylindrical part can be held firmly in contact with the locating surfaces, and the vee block can be secured to a machine table or a cast iron surface plate, for instance. When the switch is turned to the "off" position, the residual magnetism causes the work to be lightly held so that the vee block can be moved with little risk of disturbing the setting of the piece.

All surfaces of the body are ground accurately square and parallel with each other, so that with the exception of the end face which carries the switch, they can be used for location purposes. Weighing 6¾ lb., the vee block is 3 in. long by 2⅝ in. wide by 3¼ in. high.

An Automatic Austempering Plant

By R. S. McFALL* and C. A. McFADDEN†

When the International Business Machines Corporation decided to build a new plant near Kingston, New York, U.S.A., for the manufacture of typewriters, including their electrically-operated machines, plans were made for increasing efficiency by the provision of automatic machinery, wherever possible. Among the typewriter components then being made were type bars such as that seen in Fig. 1, which is here shown slightly smaller than actual size. This bar has an overall length of 4⅝ in., is $\frac{5}{32}$ in. wide, and is blanked from 0·040-in. thick, AISI 1040 steel strip. For the electric typewriter, each bar has a type character soldered to the straight edge of the angled portion at one end, and it is supported by a pin which passes through one of the holes at the other end. When a key is pressed, the bar is turned about this pin, so that the type character strikes the paper.

Because of the high operating speed of an electric typewriter, the type bar must have a tough structure, with a hardness between 42 and 44 Rockwell C., and the shank must be flat within ±0·001 in. After they have been blanked, and before they are heat treated, these bars are formed to the required angles at the head end, the angle being slightly different for each of the 42 bars employed in the machine, and the heat treatment must not cause distortion. The material from which the bars are made contains carbon 0·37 to 0·44, manganese 0·6 to 0·9, phosphorus 0·04 (max.), and sulphur 0·05 (max.) per cent, and the original austempering heat treatment was performed in two salt bath furnaces served by a team of five men. In addition to labour costs, considerable maintenance work was necessary, large quantities of salt and other supplies were consumed, and expensive fixtures had to be replaced periodically.

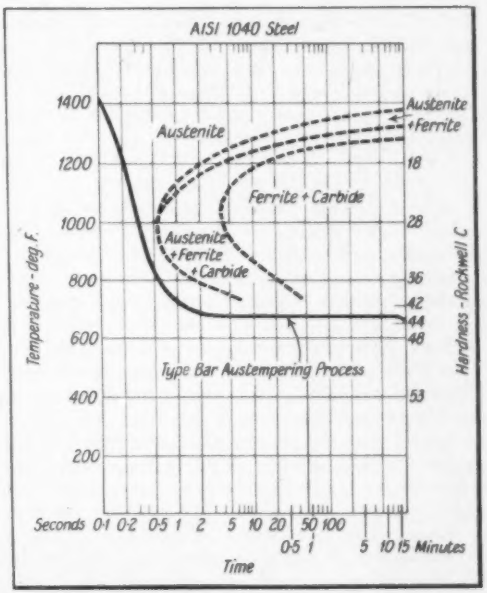


Fig. 2. Isothermal Transformation Curves for AISI 1040 Steel. The Full-line Curve Indicates the Heat Treatment to which the Type Bars are Subjected to Produce a Hard, Tough Bainitic Microstructure

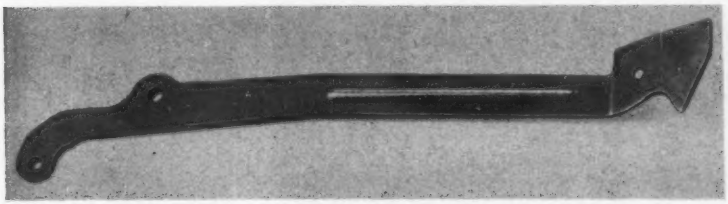


Fig. 1. A Type Bar for an I.B.M. Electric Typewriter, made from AISI 1040 Steel Strip, 0·040 in. Thick and 4⅝ in. Long, which is Subjected to an Austempering Heat Treatment

Isothermal quenching curves for AISI 1040 steel are shown dotted in Fig. 2, and the original process, which is now performed automatically, included raising the bars to a tem-

* International Business Machines Corporation, U.S.A.
† Selas Corporation of America, U.S.A.

perature of 1,400 deg. F. in the high temperature salt bath. From this temperature the bars were quenched in the second salt bath which was maintained at a temperature of 680 deg. F., and were held in this bath for a minimum of 15 min. Upon immersion in the quenching bath, the speed of cooling to the quenching bath temperature exceeds the critical quenching rate. The steel is then held at this temperature for the period mentioned, during which the austenitic structure is slowly changed into bainite, which has a needle-like structure resembling that of tempered martensite produced by a conventional heat-treatment cycle.

In Fig. 3 are seen photomicrographs, at 500× magnification, of the structure of the steel before and after the austempering heat treatment in the new plant, and it may be noted that the structure is similar to that obtained by the original procedure. The spheroidal structure of the steel is changed by the treatment into the fine-grained bainite shown, which satisfies the hardness requirements mentioned. After removal from the second salt bath furnace, the type bars were allowed to cool to room temperature before the salt was washed off. In addition to the increased efficiency which, it was anticipated, would result from employing an automatic plant for this work, it was envisaged that the plant could be installed in the production line adjacent to the presses and other machines for producing the type bars. Handling, and transportation of the bars to and from the heat treatment shop, would thus be avoided.

The layout of the new plant was decided by I.B.M. production engineers in conjunction with process development engineers from the Selas Corporation of America, who had been selected to supply the equipment. Studies showed that although a fixed treatment time was essential for the isothermal quenching portion of the treatment, as shown by Fig. 2, the initial heating of the bars and the final cleaning operations, which were all to be performed by the automatic plant, could be accelerated without affecting the quality of the results obtained. It was decided that the bars should be raised initially above the austenitizing temperature by passing them through a furnace operating at a high temperature, quenched, without contact with air, in a conveyorized salt bath maintained at the temperature specified earlier, and then washed to remove the salt.

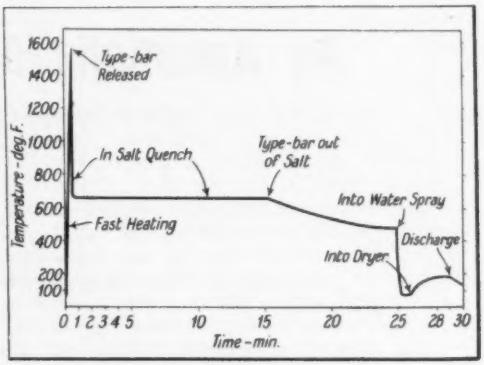


Fig. 4. In Developing the Sequence of Operations Required in an Automatic Plant for the Austempering Heat Treatment, this Time-temperature Curve was Obtained

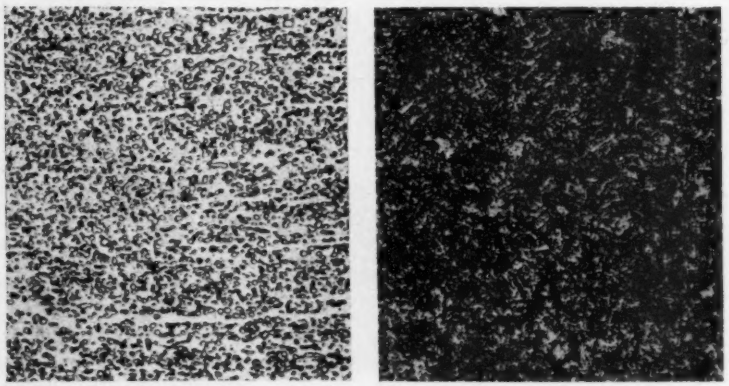


Fig. 3. Photomicrographs, at 500 × Magnification, of the Structure of AISI 1040 Steel Before (left) and After (right) the Austempering Heat Treatment

A simplified furnace was built and a pilot batch of several thousand parts was processed to check the proposed layout, and the time-temperature curve shown in Fig. 4 was obtained. From this curve it will be seen that the bars are heated to a temperature of 1,550 deg. F. in a period of only 25 sec., and immediately quenched in the salt bath, which is maintained at a temperature of 680 deg. F. The bars

remain in the salt bath for 15 min. and are then to be allowed to cool to 500 deg. F. before passing through a water spray which removes the salt carried over. Finally, the bars are dried by passing them through a heated chamber, the whole process occupying a period of less than 30 min.

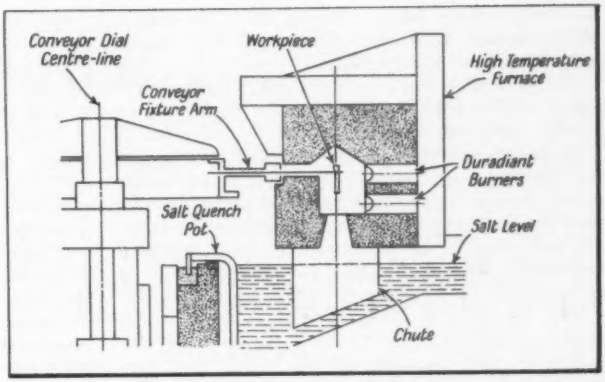


Fig. 6. Diagram Showing a Section Through the High-temperature Furnace which has an Annular Tunnel Heated by a Mixture of Gas and Air. The Type Bars are Raised to a Temperature of 1,550 deg. F. in 25 sec.

AUTOMATIC HEAT TREATMENT PLANT

A wash drawing of the plant which was developed to carry out these operations is shown in Fig. 5, where the high temperature furnace is seen at the left-hand end. This plant has now been in operation for more than a year, and has proved so successful that another similar installation, for heat treatment of cam levers, is now under construction. Designed for a through-put of 3,000 type bars per hour, the plant incorporates a wheel type conveyor to carry the bars through the high-temperature furnace. This conveyor has a number of fixtures, of heat-resisting chrome-nickel alloy, on its periphery, to hold the type bars in a vertical position. The type bars are hand loaded into the fixtures at three positions, and are carried by the continuously-moving conveyor through the furnace chamber, which is of semi-circular form.

The furnace is maintained at a high temperature by means of Duradiant gas burners set in horizontal rows in the outer refractory wall. Each burner consists of a ceramic cup in which a controlled mixture of natural gas and air is burned, and is so arranged that the flame clings to the cup and heats it to incandescence. The burners are only 4 in. from the type bars as they pass, but there is no direct impingement of flame on the bars, which are heated only by radiation, combustion being virtually completed within the cups. Controlled combustion of a rich gas-air mixture in the enclosed furnace produces a slightly reducing atmosphere, and the pressure generated prevents atmospheric air from entering. A sectional diagram of the furnace is shown in Fig. 6, with the wheel type conveyor on the left, and one of the fixtures at the position at which the type bar is released. This position

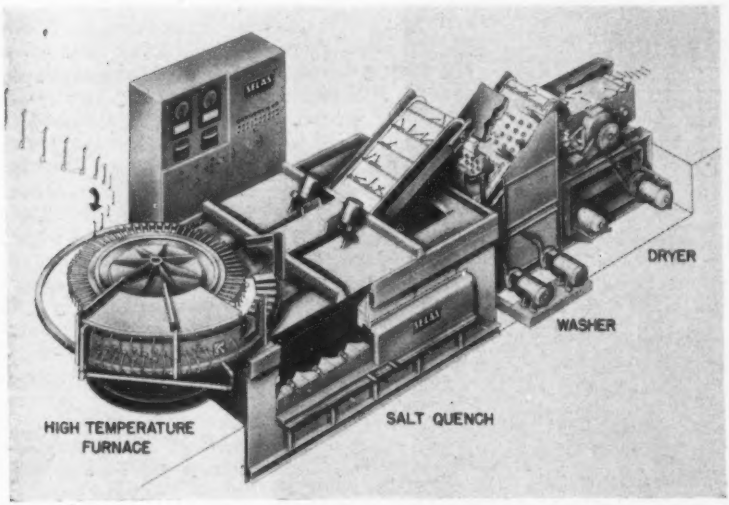


Fig. 5. Wash Drawing of the Complete Plant Built by the Selas Corporation of America for the Automatic Austempering Heat Treatment of Type Bars, Showing the Arrangement of the Four Units

is directly above the quenching salt bath, and a chute extends from the underside of the furnace into the salt, to exclude air.

The salt bath unit is also seen in Fig. 5, and it has a welded steel pot for the salt, which is completely enclosed to prevent splash. A row of Duradiant burners on each side of the pot provides for heating, and twin propeller-type agitators, driven by electric motors mounted above, ensure that the salt temperature is maintained uniformly, within 2 deg. F. of the pre-set value, throughout the bath. Partially immersed in the salt bath is an inclined slat conveyor on which type bars fall.

This conveyor is driven at a slow speed by an electric motor and extracts the type bars from the salt after the minimum period of 15 min. has elapsed. At the top of the conveyor, the bars fall off down a chute which leads them into the washing unit where they are further cooled and cleaned by re-circulated water sprays. Another inclined conveyor then carries the bars into the drying unit at the extreme right in Fig. 5, in which air, heated by a Selas direct flame gas burner, is circulated to dry them before they are ejected.

Fig. 7 shows a view of the plant installed in the I.B.M. factory, with the drying unit in the foreground. The plant is slightly more than 25 ft. long by 8 ft. 6 in. wide, and when installed in the 2-ft. 4-in. deep pit shown, it projects above floor level to a maximum height of approximately 5 ft. Loading is performed at a height of approximately 3½ ft. above the floor, at the far end of the plant, by three operators. All the control equipment is contained in adjacent cabinets, as seen at the left and in the background. This equipment includes a Selas gas combustion controller, which incorporates a sleeve-type mixing valve and automatically supplies the gas and air in the required proportions irrespective of any large variations in demand that may occur.

A compressor is employed to pressurize the gas-air mixture for delivery to the burners. In addition there is a motor-operated valve, controlled by means of a thermo-couple in the high temperature furnace, which regulates the supply of fuel mixture to the burners.

Similar arrangements are employed for the control of the salt bath temperature, and recording instruments are incorporated in the cabinets to show variations. Among the advantages which have been obtained as a result of installing this plant are the reduction in the number of operators from five to three, reductions in salt losses, and elimination of the unpleasant and possibly dangerous operation of removing sludge from the high temperature salt bath periodically. Loss of production time on account of maintenance work has also been materially reduced. In addition, there has been a reduction in the number of bars which is rejected at inspection after heat treatment.

Fig. 7. General View of the Automatic Austempering Plant Installed in the I.B.M. Factory at Kingston, New York, from the Delivery End, with the Drying Unit in the Foreground

MACHINING RECTANGULAR PORTS IN HYDRAULIC VALVE SLEEVES—Valves employed, for example, in flight-control systems of aircraft and guided missiles must be produced to very close limits of accuracy, and equipment developed specially for operations on valve components was recently demonstrated by the Sheffield Corporation, Dayton, Ohio, U.S.A. Among the problems involved are those associated with the machining of rectangular ports in hardened valve sleeves. For this purpose, the sleeve was held in a trunnion type fixture and a roughing operation was carried out on an electrical discharge machine which gives comparatively rapid penetration. Subsequently the sleeve, still held in the fixture, was transferred to an adjacent Cavitron machine, on which the ports were finished with the necessary precision by the ultrasonic process.

News of the Industry

Sheffield

DECLINE IN DEMAND FOR STEEL. The fall in demand for certain types of steel is reflected in the closing down of furnaces in some of the melting shops in the area. Some short-time working is reported by a few firms, but the larger works, generally, continue to operate at a high level of capacity. The call for stainless, rustless, and heat- and wear-resisting steels is maintained at a good level, and the makers of chemical plant are good customers for acid-resisting steel.

ACTIVITY IN HEAVY ENGINEERING PLANT. Makers of heavy machinery and engineering plant are fully occupied, and, in spite of increasing competition from abroad, some works have important overseas contracts on hand. Makers of railway wheels, axles, springs, tyres, manganese points and crossings have good orders on their books, and demand for railway carriages and wagons, both at home and abroad, is maintained at a satisfactory level. The position is equally satisfactory as regards electric traction motors, mining equipment, and hollow-forged steel boiler drums. In the tool-making branches business is steadily maintained at about the recent levels.

ENGLISH STEEL FORGE AND ENGINEERING CORPORATION, LTD., recently supplied two 68-ton boiler drums, made under contract to International Combustion, Ltd., Derby for the new Tallawarra power station, New South Wales, Australia, and they were dispatched almost totally enclosed by timber. The packing was secured by steel bands and each end was closed by a timber disc. Packing, never previously carried out by E.S.C., was necessary to protect the stub-tubes and nozzles (212 stub-tubes and 93 nozzles on each drum) welded to the drums. In addition to the packing, each of the drums was supported on six 12-in. square oak timbers. The overall length of each drum was 43 ft. (45 ft. with packing), outside diameter 74⅝ in., bore diameter 66 in., and approximate gross weight 70½ tons.

DARWINS, LTD., Tinsley, have drawn our attention to their Tru-process castings, produced by a method which enables close limits to be maintained, with a high standard of finish.

The process can be employed for parts with intricate surface detail, or of complicated shape, which do not lend themselves to normal machining methods, also for moulding tools for the plastics industry, die casting dies, forging dies, and other tools. Castings have been made successfully from the firm's special alloy steels, produced by high-frequency melting, including stainless, heat-resisting, and tool steels. In a recently-issued brochure these castings are described, and numerous applications are illustrated.

J. STEAD & CO., LTD., a member of the Darwin

In the photograph, which was taken on the occasion of the Centenary Ball held by Thomas Mercer, Ltd., Eywood Road, St. Albans, at Watford Town Hall, are seen (left to right) Mr. Frank Mercer, chairman of the company, Mrs. F. A. Mercer, Mr. F. A. Mercer, director, Mrs. T. G. Mercer, Mr. T. G. Mercer, J.P., managing director, and Mrs. Frank Mercer

group, report a brisk demand for plastics-handled screwdrivers of all types, including combined neon testers and screwdrivers. Other active lines include plastics-handled wood chisels and a new adjustable oval tube hacksaw frame, with shatterproof plastics handle.

FIRTH BROWN TOOLS, LTD., are experiencing a well-maintained demand for all types of engineers' cutting tools, including twist drills, combination centre drills, reamers, milling cutters, end mills, serrated-blade milling cutters, circular saws, butt-welded lathe and planer tools, tool-holder bits, ground thread taps and and chaser dies, metal slitting saws, segmental type circular saws, files, and hacksaw blades. Our attention was drawn to the firm's high-rake milling cutter with chip control, which was described in MACHINERY, 92/1155—16/5/58. Other work in hand includes Hardometer hardness testing machines of various types.

KAYSER, ELLISON & CO., LTD., are receiving a steady flow of orders for high-grade special steels, including alloy constructional steels, oil-hardening alloy tool steels, and Kelock high speed steels. Various grades of material can be supplied as black bars, blanks, and forgings, or in drawn or centreless ground bar fom. At present the annealing department at the Carlisle works is being re-housed, reorganized, and extended, as part of the general programme of modernization which is being undertaken.

JOHNSON & ALLEN, LTD., Smithfield, have recently produced a 30-ft. long crack detector, which incorporates a new air control circuit, designed by Mr. R. N. Stothert, consulting engineer. This circuit gives a constant rate of lowering and lifting, and the pneumatic equipment minimises manual effort and avoids the need for overhead hoists. The A.C. current flow crack detecting method employed enables 5-ton bars of various lengths and sizes to be inspected by one operator. H. B.

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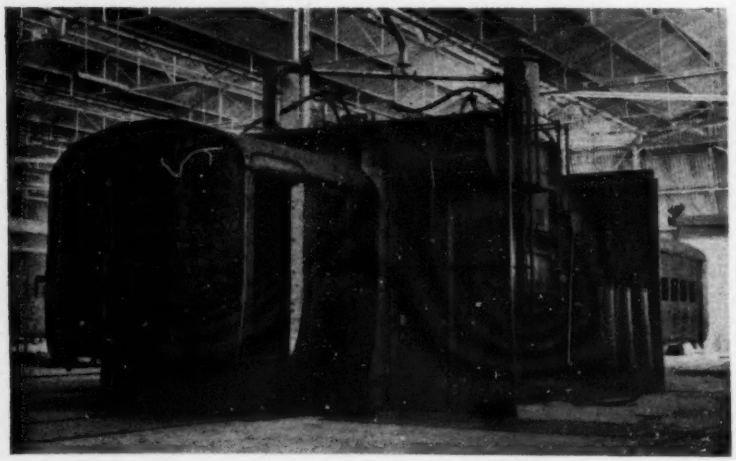
In the illustration is shown part of a large shot blasting plant built by H. G. Sommerfield, Ltd., 8 Camden Road, London, N.W.1, for the India State Railways for cleaning 30-ft. long railway coaches



London and the South

VAUGHAN ASSOCIATES, LTD., 4 Queen Street, Curzon Street, W.1, inform us that there is increasing interest in their extensive range of high production machine tools, and numerous visitors to the show rooms at Nottingham are bringing their own workpieces for demonstrations on these machines. New items which will shortly be on view at these premises include the Zentra-Plan automatic centring and facing machine, of special interest to firms already using the +GF+ copying lathes, and the Schubert precision flattening machine. The latter has been developed to reduce the cost of flattening precision pressed components hitherto finished by the conventional planishing methods.

RUDOLPH CARNE & CO., LTD., Fishers Lane, Chiswick, W.4, have recently made alterations to their premises, including provision for storage of additional spare parts for the wide range of machine tools on their agency list. Extra lifting equipment now installed enables loads of up to four tons to be handled in the receipt and despatch bay. A well-equipped workshop on the premises is utilized for the production of additional parts required to adapt standard machine tools for special purposes, also for the manufacture of a swivel vice which is reported to be selling well. This firm has supplied many universal milling

machines by Auron and by Dufour and has established a demonstration and maintenance service for these machines which covers Great Britain. A stock of machine tool accessories is maintained, and a full range of Clare chucks and collets is usually available for immediate delivery.

A. R. WADE & CO., LTD., North Lane, Aldershot, Hampshire, make furnaces for a wide range of applications among which may be mentioned the brazing of stainless steels and Nimonic alloys, also the heat treatment of large jet pipes for gas turbines. Furnaces for these purposes will be described in MACHINERY in the near future. Demand for specialized equipment of this nature is increasing, and the company, by virtue of its experience in the field, is receiving many enquiries for heat treatment ovens and furnaces, of various types.

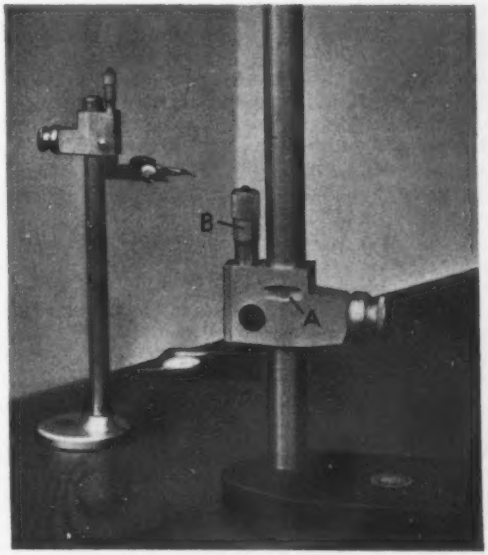
CLOSE TOLERANCE CASTINGS, LTD., Rutherford Way, Crawley, recently held a demonstration of melting and casting alloy steel under vacuum. For this purpose, a new furnace made by Clino Foundry Supplies, Ltd., Forest Hill, London, S.E.23, was used. Samples of steel equivalent in composition to Crown Max and weighing 5 lb. were melted and poured in vacuo, the melting operation being observed through an inspection window. With a power input of 18 kVA. this furnace, in which an indirect arc is employed for melting the charge, can handle 10 lb. of metal in a cycle time of 32 min., when in regular operation. It may be used for producing ingots as well as castings by the investment or Shaw processes.

THOMAS HATCHARD & CO. (TOOLMAKERS), LTD., Maple Works, Old Shoreham Road, Hove, Sussex, are still actively engaged in the production of a wide variety of tools, jigs, and fixtures for the aircraft, motor vehicle, and other engineering industries. Recently a drawing office was added to the premises which are of post-war construction and provide an area of 10,000 sq. ft. Extra space to the rear of the works has been acquired in connection with plans for future expansion. Additional machine tools have been installed to enable an increasing volume of work to be undertaken, and the precision equipment available included a Newall 2436 jig boring machine. Heat treatment facilities are also provided.

C. B. POWELL, LTD., 1 St. Joseph's Close, Hove, 4, Sussex, are well established in their new premises which are so constructed as to afford very good facilities for the designers and draughtsmen employed, who now number about 24. This firm, established 13 years ago, is concerned with designing and detailing of engineering production equipment, including rotary and linear type transfer machines for the motor vehicle industry. For several years, work has been carried out for leading aircraft manufacturers, and equipment has been designed for the production of gas turbine blades. Various special-purpose machines incorporating proprietary unit heads are at present being designed.

ALL PRECISION ENGINEERING, LTD., Kings Road, Horsham, Sussex, are still busy with orders for engineering equipment and precision instruments, including two sizes of the A.P.E. Microball height gauge, both of which are shown in the accompanying illustration. The larger gauge, which has lately been introduced, was shown on the stand of A. Capp and Son, Ltd., at the recent Gauge and Tool Exhibition at Olympia. This new gauge has a column height of 24 in. and is equipped with a special Verdict dial gauge which is not graduated but has a zero mark only. The height reading is obtained by noting the figure on the column at *A* and the graduations on the 0·0005-in. Shardlow micrometer at *B*. The cursor is located by accurately ground steel balls, each of 1 in. diameter, contained within the slotted tubular column. The smaller, 12-in., height gauge, which is of similar construction, was described in MACHINERY, 89/980—26/10/56.

F. W. H.



The New Microball 24-in. Height Gauge is Here Shown with the Original 12-in. Gauge

British Electrical Power Convention

The tenth British Electrical Power Convention and an accompanying exhibition of electrical products were held recently at Brighton, Sussex. The chairman of the English Electric Co., Ltd., Sir George Nelson, Bt., LL.D., M.I.Mech.E., M.I.E.E., gave the presidential address at the opening of the convention, which was attended by 1,000 delegates from 40 organizations representing many sections of the British electrical industry. Five papers were presented, as follows: The Development of Nuclear Energy for Electricity Supply in Great Britain, by Sir Christopher Hinton; The Development of Nuclear Energy for Electricity Supply Overseas, by Sir Claude Gibb; Britain's Part in Electrical Development Overseas, by Mr. H. J. Beard; The British Hydro-electric Plant and World Power Requirements, by Mr. J. C. Beverley, Mr. E. G. Teasdale and Mr. A. Wilmot; and The Development of the Electrically Equipped Kitchen, by Mr. J. I. Bernard.

The accompanying exhibition, as in previous years, was staged in tented structures, and was arranged to show a wide variety of domestic appliances and a number of products for industrial use. Many firms displayed examples of industrial lighting equipment for use under widely differing conditions. The A.E.I. Lamp and Lighting Co., Ltd., for example, showed lighting units suitable for use in corrosive, humid, and explosive atmospheres. On the stand of Atlas Lighting, Ltd., there were fluorescent lighting units available in 400 different fittings. Infra-red lamps were also featured, including a recently-introduced quartz lamp, rated at 1,000 watts, for use in paint drying ovens and for other applications, which was displayed by Siemens Edison Swan, Ltd. A coil winding machine of new design was demonstrated by Hall & Pickles, Ltd. Known as the Oakley coiling machine, it is designed to produce elements in the form of close wound, double helix or space wound spirals, from resistance wire of 0·12 to 1·00 mm. diameter. Heating cables for use in floor heating installations were displayed by Panelec (Great Britain), Ltd. A full range of mineral-embedded tubular-sheathed elements, including a new variety provided with spirally-wound radiating gills, were shown on the stand of Tetra Engineering Co., Ltd. These finned elements have a high rate of heat dissipation and can be supplied straight or bent, in several metals, up to a maximum length of 12 ft.

A prominent exhibit on the Central Electricity Generating Board's stand was a model of a typical reactor structure as now used in nuclear power stations.

Machine Tool Exports and Imports

EXPORTS OF MACHINE TOOLS

Type of Machine	Month ended March 31, 1958	Three months ended March 31	
		1957	1958
	Value £	Value £	Value £
New, complete—			
Boring machines:			
Vertical	30,400	85,743	91,108
Other	85,966	253,602	199,209
Drilling machines	217,550	594,301	551,313
Grinding (excluding thread grinding) lapping and honing machines	191,540	624,933	541,993
Lathes:			
Automatic	168,045	451,508	408,724
Capstan	183,830	704,929	524,791
Other	220,256	769,004	719,605
Screwing machines	11,370	61,632	58,383
Threading machines	45,679	209,055	121,079
Milling machines (excluding thread-milling) and gear cutting machines	199,235	582,870	679,529
Planing, shaping and slotting machines	79,856	176,428	250,180
Presses:			
Hydraulic	33,165	249,135	192,694
Other	78,954	308,706	381,946
Punching and shearing machines	31,315	84,590	109,378
Other plate and sheet metal-working machines including straightening rolls	23,258	70,937	91,833
All other machines	293,346	765,032	724,522
Used machines complete	64,445	150,131	164,456
Parts	262,025	580,440	583,399
Total	2,220,235	6,722,976	6,394,142
Destination			
Union of South Africa	168,353	319,479	496,884
India	391,162	919,978	1,017,910
Australia	229,355	935,047	935,376
New Zealand	31,674	119,088	119,163
Canada	214,322	399,990	480,878
Other Commonwealth countries	163,038	446,020	493,987
Soviet Union	9,264	328,051	43,218
Sweden	46,068	233,617	132,280
Western Germany	24,148	191,861	114,132
Netherlands	34,424	256,249	127,089
France	274,312	526,301	552,111
Spain	129,968	262,230	338,413
Italy	56,489	175,393	305,157
U.S. America	123,336	703,019	320,950
Other foreign countries	324,322	906,653	916,594

IMPORTS OF MACHINE TOOLS

New, complete—			
Boring machines	120,184	756,919	333,157
Drilling machines	28,409	75,630	71,141
Gear-cutting machines	27,496	290,577	94,515
Grinding, lapping and honing machines	287,470	729,296	677,020
Lathes:			
Automatic	274,630	569,195	771,866
Other	23,286	96,336	91,141
Milling machines	193,631	581,550	610,711
Planing, shaping and slotting machines	7,675	150,387	77,496
Presses	63,982	185,923	198,175
All other machines	431,646	1,076,838	972,592
Used machines, complete	27,204	56,300	92,294
Parts	319,475	1,249,024	893,382
Total	1,805,088	5,817,975	4,883,490
Country of Origin			
Western Germany	629,240	2,570,444	1,714,275
Switzerland	312,023	668,349	835,274
U.S. America	400,053	1,807,252	1,177,689
Other foreign countries	463,772	771,930	1,156,252

Economical Machining Methods for Large Parts

(*Continued from page* 3)

even or odd. In some circumstances, moreover, it might be possible to employ more than two work fixture slides in conjunction with one or more rotary tables.

Evidently this system of "bringing the machine to the work" is very adaptable, and it appears that it could be employed with advantage in numerous instances where components of a suitable nature are being produced regularly or in batches of reasonable size.

New Dunlop Composition Factory

Adhesives, at the rate of 2,000,000 gal. per year, Polimul synthetic-resin dispersions at the rate of 1,500,000 gal., and very large quantities of latex compounds and reclaim dispersions (artificial latex prepared from reclaim rubber) are being produced by the Compositions Division of the Dunlop Rubber Co., Ltd., at a factory in Chester Road, Erdington, Birmingham, 24, and are being exported to some 50 countries. Development of new products is being carried out in a modern laboratory building which is fully equipped with pilot machinery.

In the adhesives plant, which covers an area of 26,000 sq. ft., solvent-based compounds are formulated from natural and synthetic rubbers and resins, for use in the motor vehicle trimming, shipbuilding, packaging, and aircraft industries, for example. The range of about 100 adhesives produced includes type S.708 for bonding metal to metal, type S.442 for bonding metal to rubber, and type S.691 for joining metal and p.v.c.

Film on Refining Nickel

Entitled "Refining Nickel from the Sudbury Ores," the third film in the series of five which is being produced by the International Nickel Company of Canada, Ltd., was recently shown in London by the Mond Nickel Co., Ltd., Thames House, Millbank, S.W.1. The preceding films explained how nickel ore in the Sudbury area of Ontario was mined, milled, and smelted to produce nickel oxide sinter.

In this new film, the principles of electrolytic refining are considered and the processes of melting the sinter, cleaning the slag, and casting the nickel into anodes are shown. There follows a detailed technical account of the theory of electrolytic refining, together with a description of the method used to purify the electrolyte to ensure that metals other than nickel are not deposited on the cathode. The actual electrolytic refining process is then illustrated and a brief account is given at this stage of the refining of the cobalt, also contained in the sinter.

The film then deals with methods employed at Swansea for refining nickel by the Mond Carbonyl process. A laboratory demonstration of the nickel carbonyl reaction is first shown, and the pressure carbonyl process for the production of nickel powder is then described. Finally, the chemical treatment applied to the residue from the refining process, to produce salts and oxides of copper, cobalt, and residual nickel, is illustrated.

Available free on loan in the 16-mm. size, on application to the Mond Nickel Co., Ltd., the film has a running time of 52 min.

Col. F. A. Neill

Col. F. A. Neill, who was awarded a knighthood for public services in the West Riding of Yorkshire in the recent Birthday Honours, has been chairman and managing director of the family business of James Neill & Co. (Sheffield), Ltd., since he succeeded his late father in 1930.

Previously he had a distinguished army career, and when serving with the Royal Engineers in the 1914-18 war he was awarded the D.S.O. and Croix de Guerre and was four times mentioned in Despatches. From 1924 to 1929 he was C.R.E. 49th West Riding Divisional Royal Engineers, and is hon. colonel of the 106 Field Engineer Regiment (T.A.).

In 1937-38, Col. Neill was Master Cutler and he was made a C.B.E. in 1942. He is hon. vice-president of both the National Federation of Engineers' Tool Manufacturers and the British Hacksaw Makers' Association, and a member of the Gauge and Tool Advisory Council. In addition he is a member of the council of Sheffield Chamber of Commerce, of which he was formerly president, and of the East and West Ridings Council of the Federation of British Industries.

He was High Sheriff for Yorkshire in 1955-56 when Sheffield first became an assize town, and has been a deputy lieutenant of the West Riding since 1939 and a Sheffield magistrate since 1942.

Safe Practices for Inert-gas Welding

The American Welding Society, 33 West 39th Street, New York, U.S.A., have issued the second edition of their standard publication AWS A6.1-58, entitled "Recommended Safe Practices for Inert-gas Metal-arc Welding." All the hazards peculiar to such welding processes are covered, including the danger which may exist of phosgene formation as a result of the presence of trichloroethylene. Data are also included on carbon-dioxide shielding which may, in certain circumstances, introduce a risk of carbon-monoxide poisoning. The pamphlet is available from the above address at the price of 1 dollar.

Industrial Notes

B. O. MORRIS, LTD., Briton Road, Coventry, have recently started to manufacture Hammond automatic polishing machines under licence from the U.S.A.

INDUSTRIAL FILM FESTIVAL.—The second festival of films in the service of industry will be held at Harrogate from April 21 to 24, 1959, under the Presidency of Lord Godber.

THE DU PONT CO. (UNITED KINGDOM), LTD., 5 Charles II Street, London, S.W.1, are to build an Elastomers research laboratory at Hemel Hempstead, Herts. The facilities provided will assist rubber manufacturers in this country to take advantage of the latest advances in research, testing, and manufacturing processes.

ROTO-FINISH, LTD., 39 Park Street, London, W.1, have introduced a new design of steel tray for use with their type DW 16-16-2 midget barrelling machine. The base of the tray is perforated with square holes, and permits more effective separation of chips from parts than is possible with a wire screen.

STEELS ENGINEERING PRODUCTS, LTD., Crown Works, Sunderland, have recently introduced the L.5012 Conqueror mobile crane, which has a 45-ton lift at 10-ft. radius, with a 50-ft. centres strut jib. The chassis is powered by a 6-cylinder Rolls-Royce engine which develops 250 b.h.p.

THE MANAGEMENT CONSULTANTS ASSOCIATION, 4 London Wall Buildings, London, E.C.2, have issued a folder entitled "consultants to management—an expanding profession," in which are briefly outlined the qualities sought by consultants in recruiting their staffs. Copies of the folder are obtainable from the Secretary at the above address.

THE BIRMINGHAM MUSEUM OF SCIENCE AND INDUSTRY has been presented with a 2-h.p., 1,200-r.p.m., D.C. motor, which was made in 1900 at the Chelmsford works of Crompton & Co., now a part of the Crompton Parkinson organization. This motor was in use until quite recently, for driving line shafting at a printing works, and is reported to have given many years of trouble-free service.

THE 19TH INTERNATIONAL COMMERCIAL MOTOR TRANSPORT EXHIBITION, organized by the Society of Motor Manufacturers and Traders, to be held at Earl's Court, London, will be opened at 12 noon on September 26 by the Rt. Hon. Harold Watkinson, M.P., Minister of Transport and Civil Aviation, and will remain open daily from 10 a.m. to 9 p.m. (except on Sunday) until October 4.

THE BRITISH WELDING RESEARCH ASSOCIATION, 29 Park Crescent, London, W.1.—The latest list of publications of the Association covers research reports on such subjects as welding metallurgy, welding and allied processes, and strength and design. A separate section is devoted to memoranda and handbooks under the sub-headings: welding techniques, design, inspection and quality, heat treatment, health and safety, and allied production aspects.

SALES AUDITS, LTD., Pemberton House, Pemberton Row, London, E.C.4, have drawn our attention to the services which they offer to managements in connection with sales audits. It is suggested that a company's sales policies and practices should be audited from time to time, no criticism of those responsible being implied. This technique, it is stated, has been widely adopted in the U.S.A.

ASSOCIATED ELECTRICAL INDUSTRIES, LTD., Crown House, Aldwych, London, W.C.2, inform us that the A.E.I. Turbine-Generator Division, managed by Metropolitan-Vickers Electrical Co., Ltd., and the A.E.I. Heavy Plant Division, managed by The British Thomson-Houston Co., Ltd., recently became operative. The Divisions will handle the design, manufacture, and sales of all products falling within these categories.

HEENAN & FROUDE, LTD., Worcester, are putting into production a completely new range of Froude hydraulic dynamometers, designed for the testing of engines developing both high powers and high speeds. These new machines, which will be known as the Froude DA type, will be available in a range of sizes. The smallest absorbs 350 b.h.p. at speeds up to 45,000 r.p.m., and the largest 54,000 b.h.p. at speeds up to 8,500 r.p.m. Their principal applications will include both gas and steam turbine testing.

PERRY INDUSTRIES S.A., 26 Rue de Bordeaux, Brussels, 6, Belgium, has been formed as a subsidiary of Perry & Co. (Holdings), Ltd., with Mr. S. V. Delo, who has had over thirty years' experience of Continental markets, as managing director. The function of this new company will be to co-ordinate and expand the sales of the Perry Group of companies in the European markets, with particular attention to the implications of the European Common Market if it comes into force.

It is pointed out that this company is quite separate from Perry Bayliss Wiley (Belgium) S.A.

VICKERS, LTD., have announced that a new large dry dock is to be constructed by Vickers-Armstrongs (Shipbuilders), Ltd., near their existing dry dock at the Palmers Hebburn ship repairing works on the Tyne. The dimensions of the new dock will be 850 ft. by 145 ft. at entrance by 35 ft. over the sill, and it will accommodate oil tankers up to 80,000 deadweight tons. Location, design and construction will be arranged so that extensions can later be made to lengthen the dock up to 1,000 ft., to cater for the projected larger tankers, up to 120,000 deadweight tons.

ADVICE ON THE CHOICE OF PAINT SPECIFICATIONS and on the techniques of paint application is among the facilities offered to industry by Imperial Chemical Industries, Ltd., Paints Division, the technical-service and colour-advisory departments of which have occupied new premises at Slough, Bucks. Comprising a single-storey laboratory block with a two-storey administration wing at one end,

the building contains rooms devoted to the testing of pre-treatment processes for metal surfaces and to the painting of parts by flow coating and electrostatic methods, for example, and equipment installed also includes gas- and electrically-heated ovens for drying painted surfaces by radiant heat and by convection.

A. A. JONES & SHIPMAN, LTD., Narborough Road South, Leicester, have acquired the sole selling rights for the Belgian Matheys range of jig boring machines for the United Kingdom and certain other territories. The range comprises the type 3A-2, which is a high-precision conventional jig boring machine; the 35-NC jig boring and vertical tool-room milling machine with optical or mechanical measuring system, suitable for the small workshop; and the SP-30, which is similar to the above but of smaller capacity and without optical measuring equipment.

This arrangement is a reciprocal one, as Matheys have been sole selling agents in Belgium, Luxemburg and the Belgian Congo, for many years, for all Jones-Shipman machine tools.

GRESHAM TRANSFORMERS, LTD., Feltham, Middlesex. A new building, specially designed for the construction of heavy transformers, up to 5,000-kVA rating, was formally opened recently at the company's Twickenham Road Works. It provides a floor area of 180 by 50 ft. with a working height of 32 ft. below the cranes, and an interesting feature is the use of electric elements embedded in the floor for space heating. The company, which is one of the Gresham Group, is very active in the Canadian market, and a separate selling organization, Gresham Transformers (Canada), Ltd., has been established there. The Gresham Group now employs 1,000 people, and the annual turnover, it is stated, approaches £2 million. Another important activity is the manufacture of electronic equipment for a wide variety of applications.

Books Received

BRONX PRESS BRAKE TOOL MANUAL. The Bronx Engineering Co., Ltd., Lye, Worcs. 70 pp.

This manual contains information on the complete range of Bronx press brakes, and, in addition to describing the wide variety of tools which can be used on these units, it gives recommendations for the best types of tools for specific purposes. The subjects in this manual have been considered from the standpoints of both the tool designer and the machine operator, and the examples of tooling which are shown range from simple applications to more intricate set-ups. The manual is fully-illustrated, with photographs and line drawings, and a comprehensive index is included.

ACCIDENT PREVENTION MANUAL. Dunlop Rubber Co., Ltd., 10/12 King Street, St. James's, London, S.W.1. 71 pp.

This manual is intended for managers and supervisory staff, and while the emphasis is on problems concerned with the rubber industry, the greater part is applicable to any type of factory. After a brief review of the history of industrial safety, the book deals comprehensively with the safety regulations concerned with the use of mechanical handling devices, including hoists and tackle, lifts, cranes, fork-lift trucks, and motorized transport in general, also prevention of accidents from other causes such as heat, electricity, chemicals, and fire.

There are six appendices, including a bibliography and a summary of the provisions of some sections of the Factory Acts, and the book is fully indexed.

A PRACTICAL GUIDE TO THE DESIGN OF STEEL CASTINGS. The British Steel Castings Research Association, East Bank Road, Sheffield, 2. 52 pp. [Price 12s. 6d.]

The Association, having acquired from Editions Techniques de la Fonderie the translation rights of their publication Guide Practique du Tracé des pièces en Acier Moulé, have published this valuable work in English under the above title. Steel casting design is covered from the standpoints of soundness, economy in production, and good engineering, and the value of the book is greatly enhanced by the inclusion of numerous line drawings showing recommended and undesirable forms. Chapters are devoted to: properties of cast steel; foundry defects attributable to bad design of the castings; design rules independent of the direction of moulding and pouring; and design rules depending on the orientation for pouring and moulding.

With its essentially practical approach, the book should be of great assistance to designers, draughtsmen, engineers, and others—including practical steelfounders and students—concerned with the specification, design, and production of steel castings for all purposes.

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2/7/58

Personal

SIR ARCHIBALD FINLAYSON FORBES, G.B.E., has been elected to the board of directors of The English Electric Co., Ltd., Marconi House, Strand, London, W.C.2.

MR. RICHARD R. T. BURROWS has been appointed technical sales representative for Adapta-Charts, Ltd., 129 Hammersmith Road, London, W.14.

MR. S. J. BURRAGE has been appointed a director of J. Parkinson & Son (Shipley), Ltd., Canal Ironworks, Shipley, Yorks.

MR. S. SMITH AND MR. E. G. HOLBERRY, chief designer and works manager respectively, of E.M.B. Co., Ltd., Moor Street, West Bromwich, Staffs., have been appointed directors of the company.

MR. J. HAMMOND has been appointed deputy chief engineer of Samuel Fox & Co., Ltd., Stocksbridge, near Sheffield, in addition to holding the position of works engineer, which he assumed last year.

MR. J. C. STEVENSON, B.Sc., F.R.Ae.S., and MR. E. F. MAILLARD, B.Sc. (Chem.), A.R.I.C., A.I.M., have been appointed chief technician and metallurgist, respectively, to Tiltman Langley, Ltd., Redhill Aerodrome, South Nutfield, Surrey.

MR. J. L. RITCHIE, B.Sc., M.I.Mech.E., has been appointed personal assistant to the managing director of The Consolidated Pneumatic Tool Co., Ltd. Mr. Ritchie has resigned from the board of Aveling-Barford, Ltd., Grantham, with whom he had been associated for 25 years.

MR. J. ESAU, MR. R. GRACE, A.M.I.E.E., and MR. J. MUNFORD have been appointed technical representatives of J. A. Crabtree & Co., Ltd., Lincoln Works, Walsall, Staffs., and will be responsible, respectively, for South Wales, North Wales and North West England, and Southern England.

MR. ROBERT W. GOODFELLOW has recently relinquished his appointment as publicity manager of Armstrong Whitworth (Metal Industries), Ltd., Gateshead, and Jarrow Metal Industries, Ltd., Jarrow, to become publicity manager of George Angus & Co., Ltd., Westgate Road, Newcastle-on-Tyne.

MR. CLEMENT MUSKETT, who was previously production manager, has been appointed works manager of Rubery Owen (Warrington), Ltd., Cleveleys Road, Warrington, in succession to Mr. J. G. Gibson, who has accepted an appointment abroad. Mr. Robert Davies, formerly chief planning and maintenance engineer, is now production manager, and Mr. George Simm, chief planning engineer.

MR. G. W. ROSE, O.B.E., T.D., A.M.I.Mech.E., has joined the board of Fisher & Ludlow, Ltd., Birmingham, as deputy managing director. He served his apprenticeship at Wolseley Motors, Ltd., and subsequently held the positions of works manager and general works manager of the Austin Motor Co., Ltd., Longbridge. MR. J. R. MOORE, formerly chief inspector of the body department of the Austin Motor Co., Ltd., has been appointed quality controller for Fisher & Ludlow, Ltd. Consequent upon the above appointments, MR. W. H. DAVIS, A.M.I.Mech.E., A.C.T.(Birmingham), A.M.I.Plant E., has been made general works manager, and MR. R. D. NIVEN, production manager (cars division) of the Austin Motor Co., Ltd. MR. C. A. J. MUNDAY has been appointed chief inspector of the body department of the same company.

Trade Publications

MONOMETER MANUFACTURING CO., LTD., Savoy House, 115/116 Strand, London, W.C.2. Illustrated leaflet describing a truck with a hydraulic-tilting molten-metal transfer ladle, which is intended for transporting molten-metal to a foundry and for feeding holding furnaces for die casting.

BRITISH RESIN PRODUCTS, LTD., Devonshire House, Piccadilly, London, W.1. Technical information sheet describing the physical properties and applications of five types of Rigidex polyethylene. These materials are suitable for sheet and section extrusions; tubes; cables; bottle blowing; injection moulding; paper-coating; and film.

CONVEYANCER FORK TRUCKS, LTD., Liverpool Road, Warrington. Leaflets giving details of the latest additions to the Conveyancer-Lande range of equipment, namely the Handtruck, the Drumtruck, and the Skidtruck, which were exhibited for the first time at the recent Mechanical Handling Exhibition.

J. A. CRABTREE & CO., LTD., Lincoln Works, Walsall. Catalogue No. 1194, covering the entire range of domestic and industrial electric accessories made by this company, including a number of new products. A separate publiction describing the new Closegang range of units will be available shortly.

DOWDING & DOLL, LTD., 346 Kensington High Street, London, W.14. Well presented and illustrated publication describing the Dowding V8 universal gear hobbing machine. Various features of design are shown, also close up views of typical set-ups. Details of the specification and capacity are clearly set out, and sectional drawing of work holding fixtures are included.

P. A. MEAD, LTD., 3 Vincent Parade, Hanley Road, Finsbury Park, London, N.4. Leaflets describing the range of top-heated galvanizing furnaces, with ceramic baths, and bright annealing furnaces, which are made by Ofenbau Fritz G.m.b.H., Hagen, for whom they are the sole selling agents in the United Kingdom. The galvanizing furnaces are suitable for treating wire, wire netting, and strip, and can be arranged for heating by either gas or oil. Bright annealing plants can be supplied for wire, strip, bars, and tubes of steel, iron, copper and other metals.

Correction

NEWALL DIVIDEND.—In MACHINERY, 92/1543—27/6/58, it was incorrectly stated that the 15 per cent dividend of Newall Engineering Co., Ltd., for the year ended March 31 last was accompanied by a capital distribution of 5 per cent. Such a distribution was made for the year ended March 31, 1957, but not for the period in question.

New Companies Registered*

ROCKWELL PNEUMATIC SCALE, LTD., Welsh Harp, Edgware Road, London, N.W.2. Registered June 10, 1958. Nom. cap.: £10,000 in £1 shares. Directors: C. E. Rockwell, J. Middleton.

THOMAS WORRALL & CO., LTD., 17 Doctors Piece, Willenhall, Staffs. Registered June 11, 1958. To carry on the business of designers, manufacturers of and dealers in locks, etc. Nom. cap.: £10,000 in £1 shares. Permanent directors: T. H. Worrall, E. Worrall, F. Worrall.

JONES BROS. (PRESSINGS), LTD., Gorsey Lane, Coleshill, Warwicks. Registered June 12, 1958. To carry on the business of manufacturers of and dealers in forgings, castings, pressings, etc. Nom. cap.: £10,000 in £1 shares. Permanent directors: J. L. Jones, G. I. Arthur.

* From the lists compiled by Jordan & Sons, Ltd., Company Registration Agents, 116-118 Chancery Lane, London, W.C.2.

Machine Tool Share Market

In stock markets an unsettled tendency developed during the period under review, and the general trend of prices was to slightly lower levels in nearly all sections.

International uncertainties, and the Federation of British Industries survey of current industrial trends, which indicated a slowing down of United Kingdom business activity, were the main influences affecting sentiment.

The gilt-edged market after holding steady to firm became irregular, and British Funds, together with other high grade fixed interest stocks, finished with a slight setback in values.

A cheerful and active start in the commercial and industrial sections was followed by more subdued conditions, and apart from a few selected features, price movements on balance were irregular, with small declines predominating.

Machine tool issues, however, were generally steady. Edgar Allen advanced 2s. 3d. to 30s. on the higher profits; Armstrong Stevens, 3d. to 8s. 6d.; Greenwood & Batley, 1s. 3d. to 48s. 1½d.; Kitchen & Wade, 6d. to 10s. 6d.; Samuel Osborn, 6d. to 17s. 6d.; Ambrose Shardlow, 6d. to 38s.; B. & S. Massey, 4½d. to 8s. 1½d.; John Shaw & Sons (Wolverhampton), 1½d. to 12s. 7½d.; and Thos. W. Ward, 1s. 6d. to 76s. 6d. On the other hand, Coventry Machine Tool lost 3d. at 8s. 6d.

EDGAR ALLEN & CO., LTD.—Final dividend 7½ per cent, making, with the interim, a total distribution of 12½ per cent (same).

COMPANY		Denom.	Middle Price
Abwood Machine Tools, Ltd.	Ord.	1/-	9d.
Armstrong, Stevens & Son, Ltd.	Ord.	5/-	8/6
Allen (Edgar) & Co., Ltd.	Ord.	£1	30/-
" " "	5% Prf.	£1	14/9*
Arnott & Harrison, Ltd.	Ord.	4/-	13/6
Asquith Machine Tools Corp., Ltd.	Ord.	5/-	18/9
" " "	6% Cum. Prf.	£1	18/6
Birmingham Small Arms Co., Ltd.	Ord.	£1	28/-
" "	5% Cum. "A" Prf.	£1	15/6
" " "	6% Cum "B" Prf.	£1	17/6
" " "	4% 1st Mort. Deb.	Stk.	86/-
British Oxygen Co., Ltd.	Ord.	£1	35/-
" " "	6½% Cum. Prf.	£1	21/3
Brooke Tool Manufacturing Co., Ltd.	Ord.	5/-	4/7½
Broom & Wade, Ltd.	Ord.	5/-	10/4½xd
" "	6% Cum. Prf.	£1	17/9
Brown (David) Corporation Ltd.	5½% Cum. Prf.	£1	14/-
Buck & Hickman, Ltd.	6% Cum. Prf.	£1	17/9
Butler Machine Tool Co., Ltd.	Ord.	5/-	5/6
" "	5% Cum. Prf.	£1	13/9
C.V.A. Jigs, Moulds & Tools, Ltd.	5½% Red. Cum. Prf.	£1	13/9xd
Churchill (Charles) & Co., Ltd.	Ord.	2/-	4/7½
" " "	6% Cum. Prf.	£1	26/3
Churchill Machine Tool Co., Ltd.	Ord.	5/-	17/9
" " "	6% Cum. Prf.	£1	18/6
Clarkson (Engrs.), Ltd.	Ord.	5/-	12/3
Cohen (George), Son & Co., Ltd.	Ord.	5/-	11/10½
" " "	4½% Cum. Prf.	£1	14/6
Coventry Gauge & Tool Co., Ltd.	Ord.	10/-	13/9
" " "	5% Cum. Red. Prf.	£1	16/3
Coventry Machine Tool Works, Ltd.	Ord.	4/-	8/6
Craven Bros. (Manchester), Ltd.	Ord.	5/-	6/7½
Elliott (B.) & Co., Ltd.	Ord.	1/-	2/9
" "	4½% Red. Cum. Prf.	£1	13/9
Export Tool & Case Hardening Co., Ltd.	Ord.	2/-	1/3
Firth Brown Tools, Ltd.	4% Cum. Prf.	£1	12/-
Greenwood & Batley, Ltd.	Ord.	£1	48/1½
Harper (John) & Co., Ltd.	Ord.	5/-	13/3
"	4½% Red. Cum Prf.	£1	13/1½
Herbert (Alfred), Ltd.	Ord.	£1	33/9
Holroyd (John) & Co., Ltd.	"A" Ord.	5/-	10/3
" " "	"B" Ord.	5/-	9/9
Jones (A. A.) & Shipman, Ltd.	Ord.	5/-	21/3
" " "	7% Cum. Prf.	5/-	5/-
Kayser, Ellison & Co., Ltd.	Ord.	£1	44/6
" " "	6% Cum. Prf.	£1	18/-xd
Kendall & Gent, Ltd.	Ord.	5/-	7/7½xd
Kerry's (Gt. Britain), Ltd.	Ord.	5/-	6/3
Kitchen & Wade, Ltd.	Ord.	4/-	10/6xd
Martin Bros. (Machinery), Ltd.	Ord.	2/-	2/4½
Massey, B. & S., Ltd.	Ord.	5/-	8/1½
Modern Engineering Machine Tools Ltd.	Ord.	5/-	8/9
Newall Engineering Co., Ltd.	Ord.	2/-	4/6
Newman Industries, Ltd.	Ord.	2/-	2/3
" " "	6% Prf. Ord.	5/-	5/6
Noble & Lund, Ltd.	Ord.	2/-	2/9
Osborn (Samuel) & Co., Ltd.	Ord.	5/-	17/6
" " "	5½% Cum. Prf.	£1	25/3
Pratt (F.) & Co., Ltd.	Ord.	5/-	20/7½
Scottish Machine Tool Corporation, Ltd.	Ord.	4/-	5/-
Shardlow (Ambrose) & Co., Ltd.	Ord.	£1	38/-xd
Shaw (John) & Sons, Wolverhampton, Ltd.	Ord.	5/-	12/7½
Sheffield Twist Drill & Steel Co., Ltd.	Ord.	4/-	33/9
" " " "	5% Cum. Prf.	£1	15/-
Stedall & Co., Ltd.	Ord.	5/-	5/9
Tap & Die Corporation, Ltd.	Ord.	5/-	7/6
" " "	4½% Deb. 1961-1977	Stk.	82/-
Wadkin, Ltd.	Ord.	10/-	18/6
Ward (Thos. W.), Ltd.	Ord.	£1	76/6
" "	5% Cum. 1st Prf.	£1	15/9xd
" "	5% Cum. 2nd Prf.	£1	24/6xd
Willson Lathes, Ltd.	Ord.	1/-	2/4½

The Middle Prices given in the list are in several cases nominal prices only and not actual dealing prices. Every effort is made to ensure accuracy, but no liability can be accepted for any error. * Sheffield price. † Birmingham price.

PRICES OF MATERIALS

All prices per ton except where otherwise stated.

Pig-Iron

Foundry and Forge No. 3, Class 2

Middlesbrough zone	£21 6 0
Birmingham	£20 18 3

Phos. 0·1 to 0·75%

Birmingham	£23 17 0

Scottish Foundry

Grangemouth	£25 3 6

Hæmatite English No. 1

N.E. and N.W. Coast	£25 6 6
Scotland	£25 13 0
Sheffield	£26 15 0
Birmingham	£27 4 0

Welsh £25 6 6

Steel Products

Medium plates	£45 11 6
Mild steel plates, ordinary*	£42 2 0
Boiler plates*	£44 12 0
†Flat bars 5 in. wide and under †Round bars under 3 in.	£40 0 6
Billets, rolling quality, soft U.T.	£32 15 6

Phosphor Bronze

Ingots (288) (A.I.D.) d/d	£258 0 0

Copper

Cash (mean)	£198 7 6
Cold rolled and hot rolled sheets 4 ft. by 2 ft. by 10 SWG	£240 10 0—£260 15 0
Rods ⅜ in. to ¾ in. diam.	£282 15 0
Tubes, 1¼ in. bore by 10 SWG, ton lots, per lb.	2s. 8½d.
Wire rod, black, hot-rolled (¼–⅜ in.) English	£214 12 6

Zinc

Refined, minimum 98 per cent. purity, current month (mean)	£65 12 6

Brass

Tubes, solid drawn, per lb.	1s. 6½d.
Strip 63/37, 6 in. by 10 SWG coils, ton lots	£222 15 0—£225 5 0
Rods, ½–3 in. diam. (59 per cent copper)	1s. 9½d.

Yellow Metal

Condenser plates, per ton	£160 0 0
Rods, per lb.	1s. 10½d.

Aluminium

Ingots min. 99·5 per cent Canadian d/d	£180 0 0

Lead

Refined, minimum 99·97 per cent purity, current month (mean)	£75 1 3

Tinplates

‡U.K. Home trade:

Handmill f.o.t. makers' works	£3 11 8½
Cold reduced, f.o.t. makers' works	£3 7 4½

U.K. Export:

Hot rolled basis, f.o.t. works' port	74s. 0d.—75s. 0d.
Cold reduced basis, f.o.t. works' port	75s. 0d.

Gunmetal

Ingots, 85.5.5.5. ex works	£168 0 0

* N.E. Coast, N. Joint Area, Central Scottish Zone.
† U.T. soft basic.
‡ Official maximum price, after allowing for adjustments for increase in price of tin.

MAKERS' PRICES

Hexagon Steel Bars[1]

Sizes in inches from 1 in. up to 2·21 and 2·41 a/f, ex works 2 ton basis	£42 17 0
Free cutting black	£47 6 6

Reeled Steel Bars[1]

Single-reeled 1½ in. upwards, f.o.t. works (+ usual extra for sizes)	£43 9 6
Free cutting	£47 19 0

High-Speed Steel

Black random length bar. All prices basic, per lb., subject to extras.

Molybdenum "66"	5s. 10½d.
Molybdenum "46"	5s 8½d.
14 per cent tungsten	5s. 9d.
16 per cent tungsten	6s. 1½d.
18 per cent tungsten	6s. 4d.
22 per cent tungsten	7s. 5d.
5 per cent cobalt	9s. 6d.
4·75/5·25 per cent molybdenum + 6·0/6·75 per cent tungsten + 1·75/2·05 per cent vanadium (5-6-2)	6s. 0½d.

Precision-ground, High-speed Free-turning Brass Rod[2]

½-in. dia. ± 0·00025-in. 2-ton lots, per lb. 2s. 2½d.

Grey Iron Rod

Die Cast[3] in random lengths 18 in. to 26 in. rough machined ⅛-in. above listed size. Extra for definite lengths. Discounts for orders over £150.

	Per cwt. net. Mark I	Mark III
¾ or ⅞ in.	245s. 4d.	318s. 10d.
1 or 1¼ in.	196s. 4d.	251s. 10d.
1½ to 1¾ in.	137s. 10d.	171s. 2d.
1⅞ to 2 in.	106s. 2d.	125s. 11d.
2⅛ to 3⅛ in.	91s. 6d.	106s. 4d.
3⅜ to 12 in.	86s. 6d.	99s. 2d.

Continuous Cast

10-ft. lengths, centreless machined 1 to 3-in. dia. + 0·010 to 0·020 in., prices as quoted for die cast bar[3]

6-ft. lengths centreless ground + 0·010 in. Extra for hardenable alloy iron[4] Per cwt. net	¾ or ⅞ in.	245s. 4d.
	1 or 1¼ in.	196s. 4d.
	1½ to 1¾ in.	137s. 10d.
	1⅞ to 2 in.	106s. 2d.
	2⅛ to 3⅛ in.	91s. 6d.

Stellite[5]

Welding Rods plain

¼ in. dia. per lb.	30s. 0d.

Toolbits

¼ in. sq. × 4 in., each	22s 3d.

Precision-ground Mild Steel[1]

1-in. dia. + 0·00025-in. 4-ton lots, per cwt.	121s. 6d.

[1] Colvilles, Ltd., Glasgow, and 17 Grosvenor Street, London, W.1. [2] Pratt, Levick & Co., Ltd., Chester. [3] Sheepbridge Alloy Castings, Ltd., Sutton-in-Ashfield. [4] "Flocast," Harold Andrews Sheepbridge, Ltd., Halesowen. [5] Deloro Stellite, Ltd., Highlands Road, Shirley, Solihull.

BASIC PRICES FROM LONDON STOCK[6]

Free Cutting Steel

Bright cold drawn: (Usaspead) over 1½ to 2 in.	£59 17 6
Lead bearing (Usaled)	£64 4 0
Precision ground, 1⅛ in.	£81 12 6

Bright Drawn

M.S. bars (M.M.C.) over 1½ in. to 2 in.	£55 3 6
Square edge flats (Usaflat)	£72 0 0
M.S. angles (Usaspead)	£99 10 0
Casehardening (EN) (Usacase) over 1½ in. to 2 in.	£63 9 6
M.S. bars (EN3B) (Usamild) over 1½ to 2 in.	£57 3 6
Carbon manganese semi-freecutting case hardening (EN202) (Usaspead 202) over 1½ to 2 in.	£72 19 0
35/45 ton tensile (EN6) (Usen) over 1 to 1½ in.	£64 17 6
0·4 Carbon Normalised (Usaspead "40") over 1½ in. to 2 in.	£66 19 6
Carbon manganese steel to Specification EN.16.T (Usaspead S565), per ton	£127 11 3

Ground Flat Stock

18-, 24-, and 36-in. lengths (Usaspead). List prices less 5 per cent

Oil Hardening Cast Steel

Non-shrink (Usaspead N.S.O.H.) ¾ in. to 2¾ in., per lb.	1s. 11d.
Non-distorting heavy duty (Usaspead H.C.H.C.) ¾-in. to 2¾-in., per lb.	4s. 2d.

Silver Steel

(0·194-in. to 1½-in.) Genuine Stubs quality, per lb.	4s. 6d. less 27½%
M.M.C. quality, per lb.	2s. 5d. + 6½%
Boxes of 16 assorted sizes ⅛-in. to ½-in. dia.	7s. 6d.

Stainless Steel

K.E. 40.AM (Freecutting), per lb. 3s. 3½d.

Glacier Machined Bronze Bars

Phosphor bronze (288)
Lead bronze
} Prices on application

High-speed Steel

18 per cent tungsten. Prices on application.

Toolholder bits:

Usaspead "Super"	List price
" "Supreme"	
" Cobalt 10	

Shimstock

Steel assorted, per tin	3s. 6d.
Brass " "	7s. 3d.

[6] Macready's Metal Co., Ltd., Pentonville Road, N.1. Subject to confirmation by London Office. Delivered free by van in London area.

ARNO

TYPE 3V VERTICAL MILLER

★ Swivelling and sliding head
★ Power feeds in three directions
★ Rapid traverses with single lever control
★ Centralised grouping of control levers
★ Hardened and ground gears
★ Schlesinger limits

Table w.s. 63" x 15"
Spindle speeds (20) 30—1,200 rpm.
Power traverses 51½" x 14½" x 21½"
Table feeds (16) .281"—22" per min.
H.P. 17
Weight 7040 lbs.

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HELMET ROW, OLD STREET
LONDON, E.C.1.
Telephone Clerkenwell 6481

STEEL PARALLELS

for superlative accuracy
at reasonable price

CROWN WORKS

GRADE 'A'
HARDENED, GROUND & LAPPED TO B.S.S. No. 906 FOR STRAIGHTNESS, PARALLELISM, SIZE AND SQUARENESS.
E.G. 12" x 3" x 1½" ± 0.0002"

GRADE 'B'
HARDENED & GROUND TO B.S.S. No. 906.
E.G. 12" x 3" x 1½" ± 0.0004"

RANGE OF SIZE

4"	x ¾" x ½"
6"	x 1" x ½"
6"	x ¾" x ¾"
8"	x ¾" x 1½"
9"	x 1" x ¾"
10"	x 2" x 1"
12"	x 2" x 1¼"
12"	x 3" x 1½"

COMPLETE IN WOODEN CASES . . . . . STOCK DELIVERY

WINDLEY BROS. LTD. CROWN WORKS · CHELMSFORD · LONDON ROAD · ENGLAND

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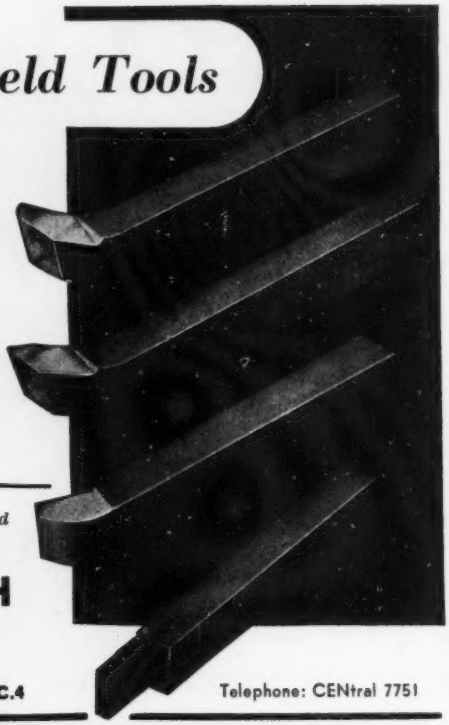

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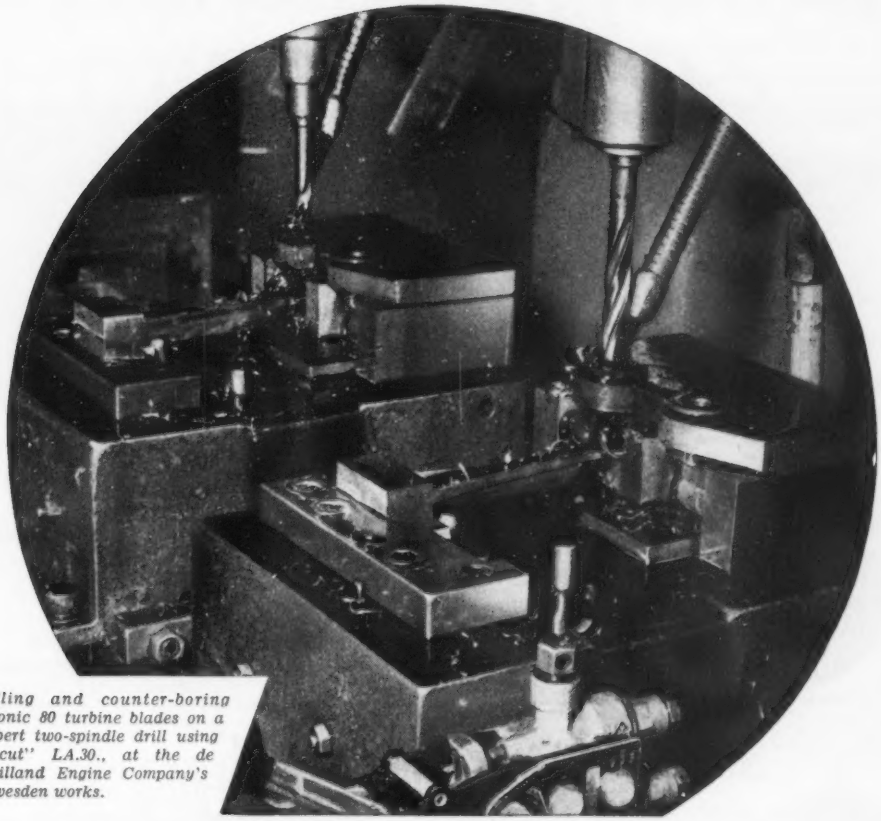

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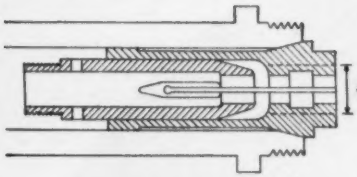

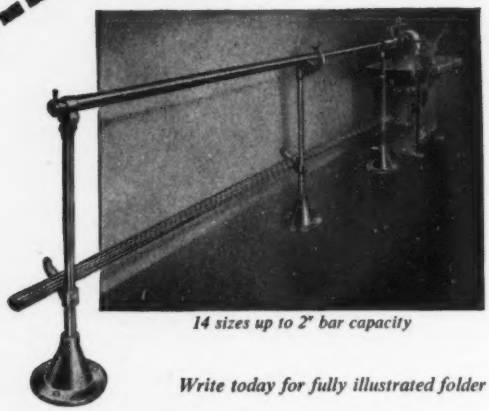

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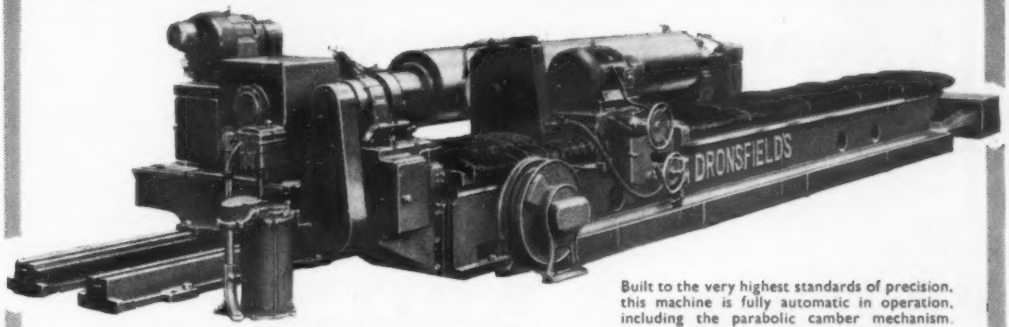

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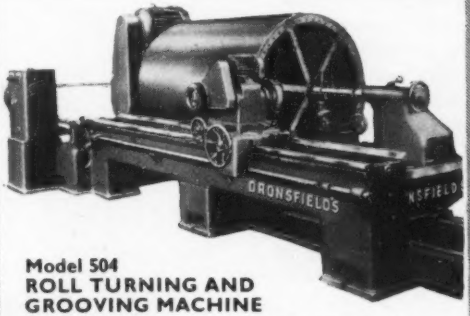

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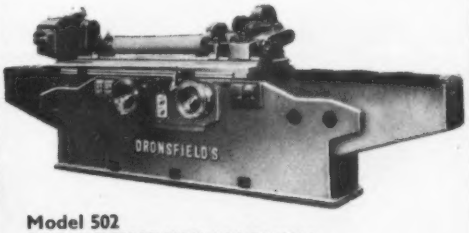

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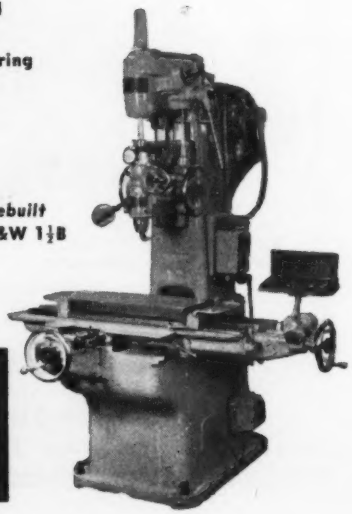

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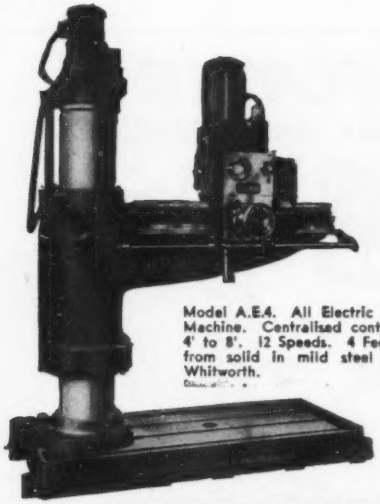

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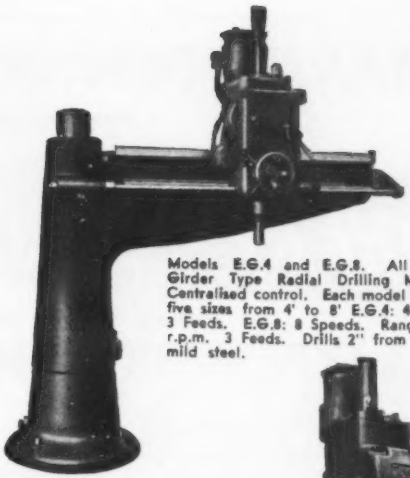

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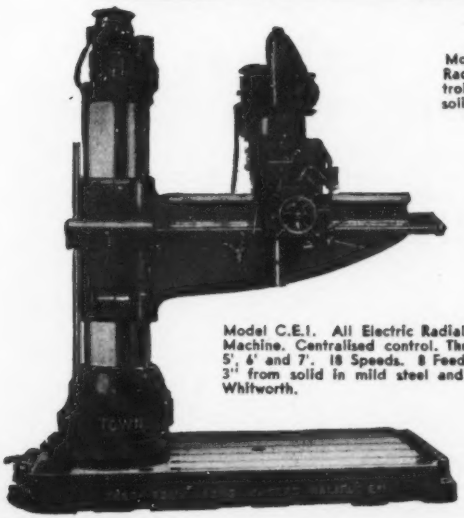

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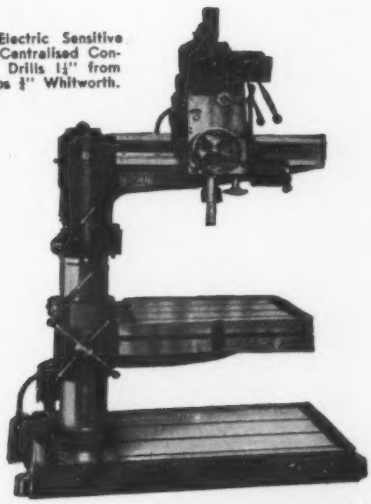

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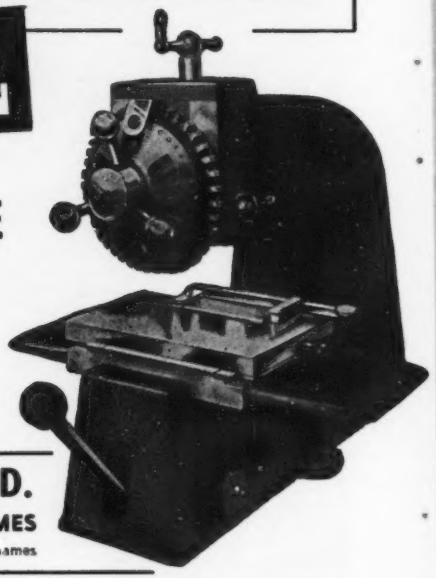

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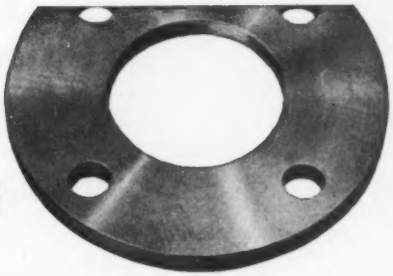

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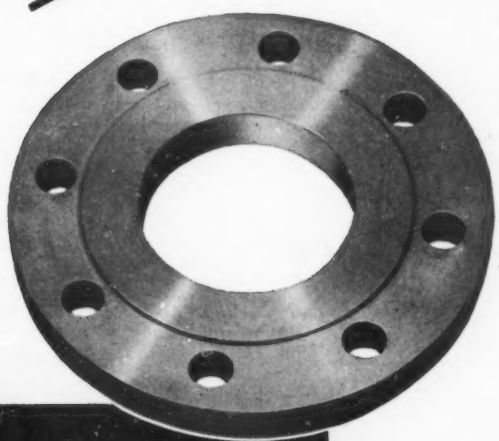

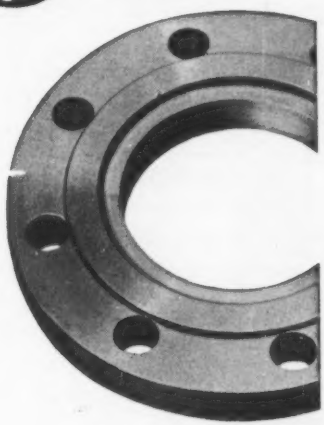

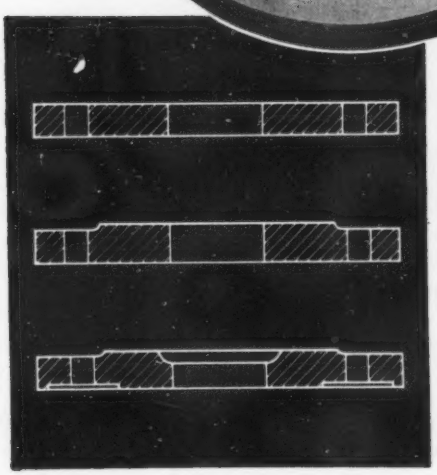

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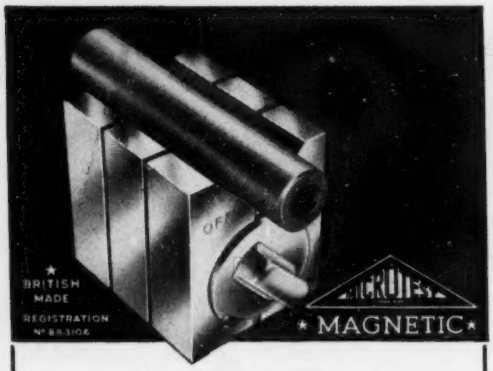

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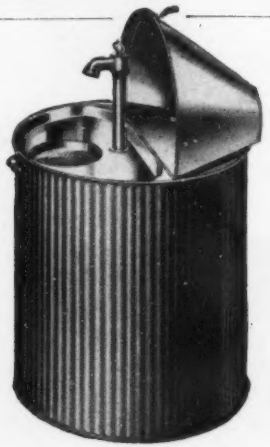

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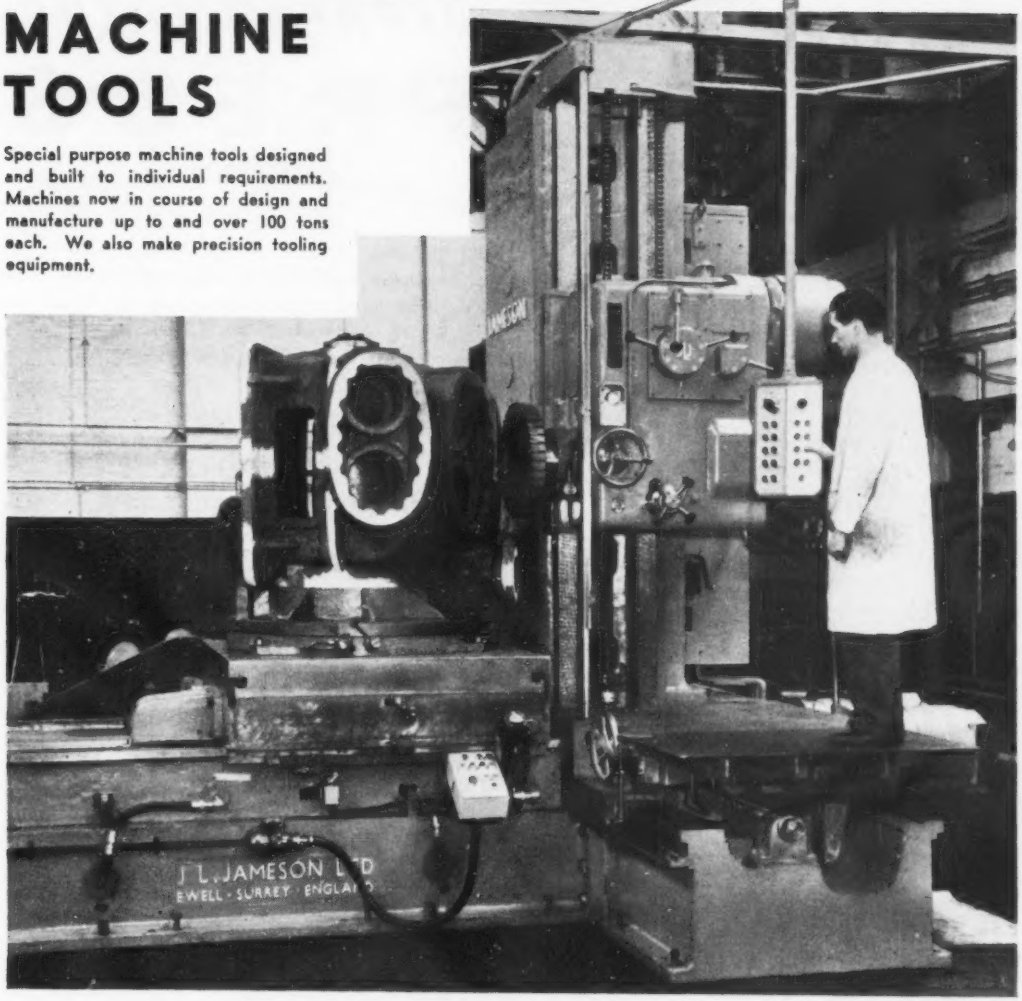

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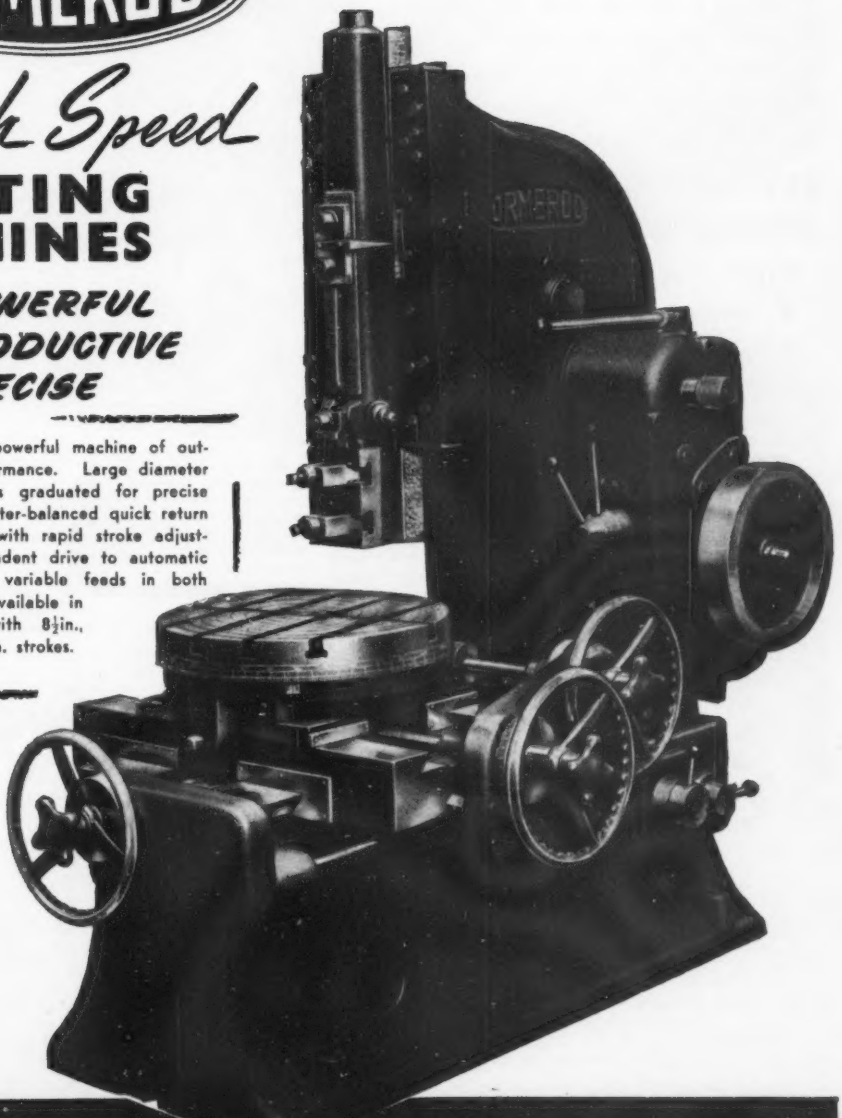

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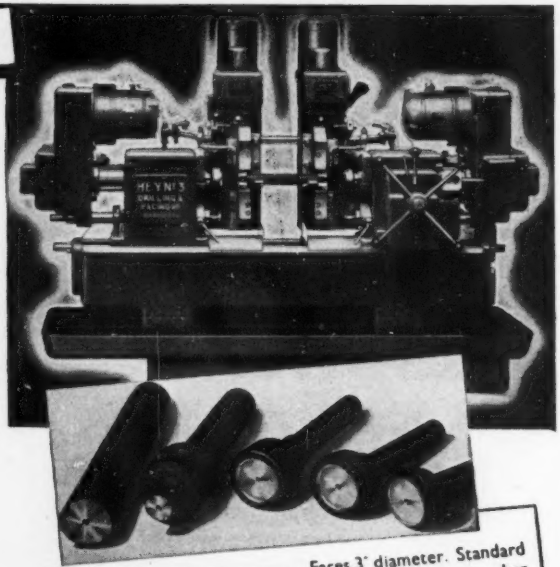

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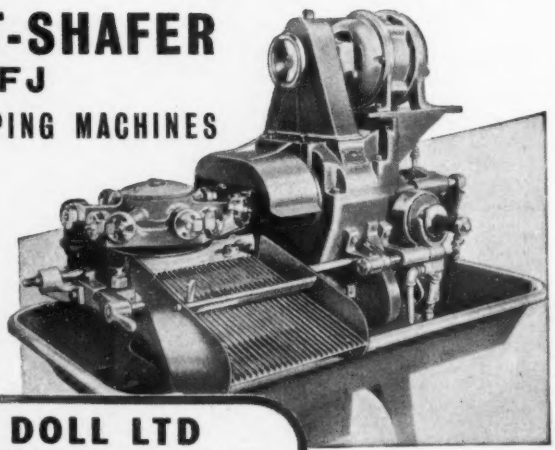

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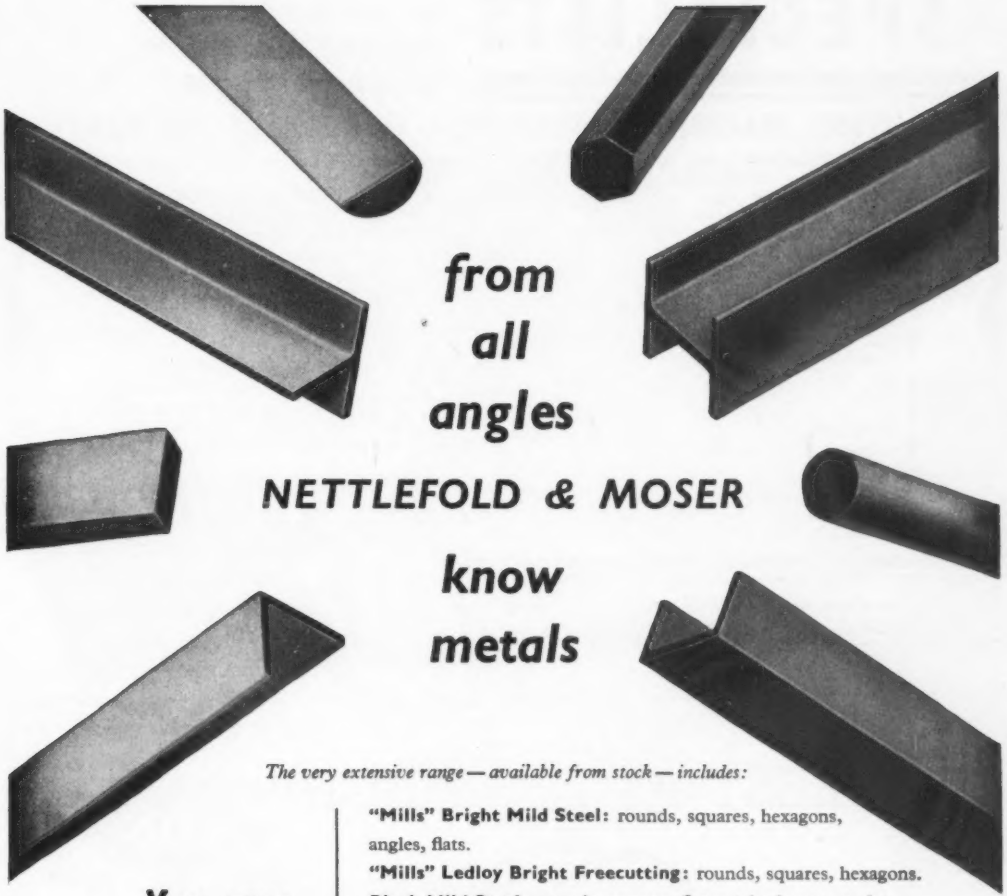

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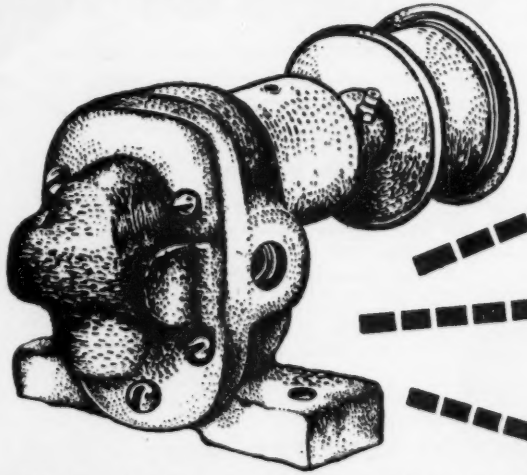

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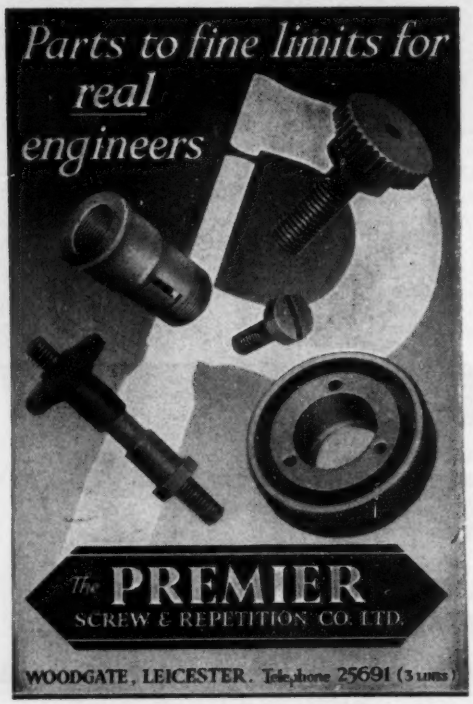
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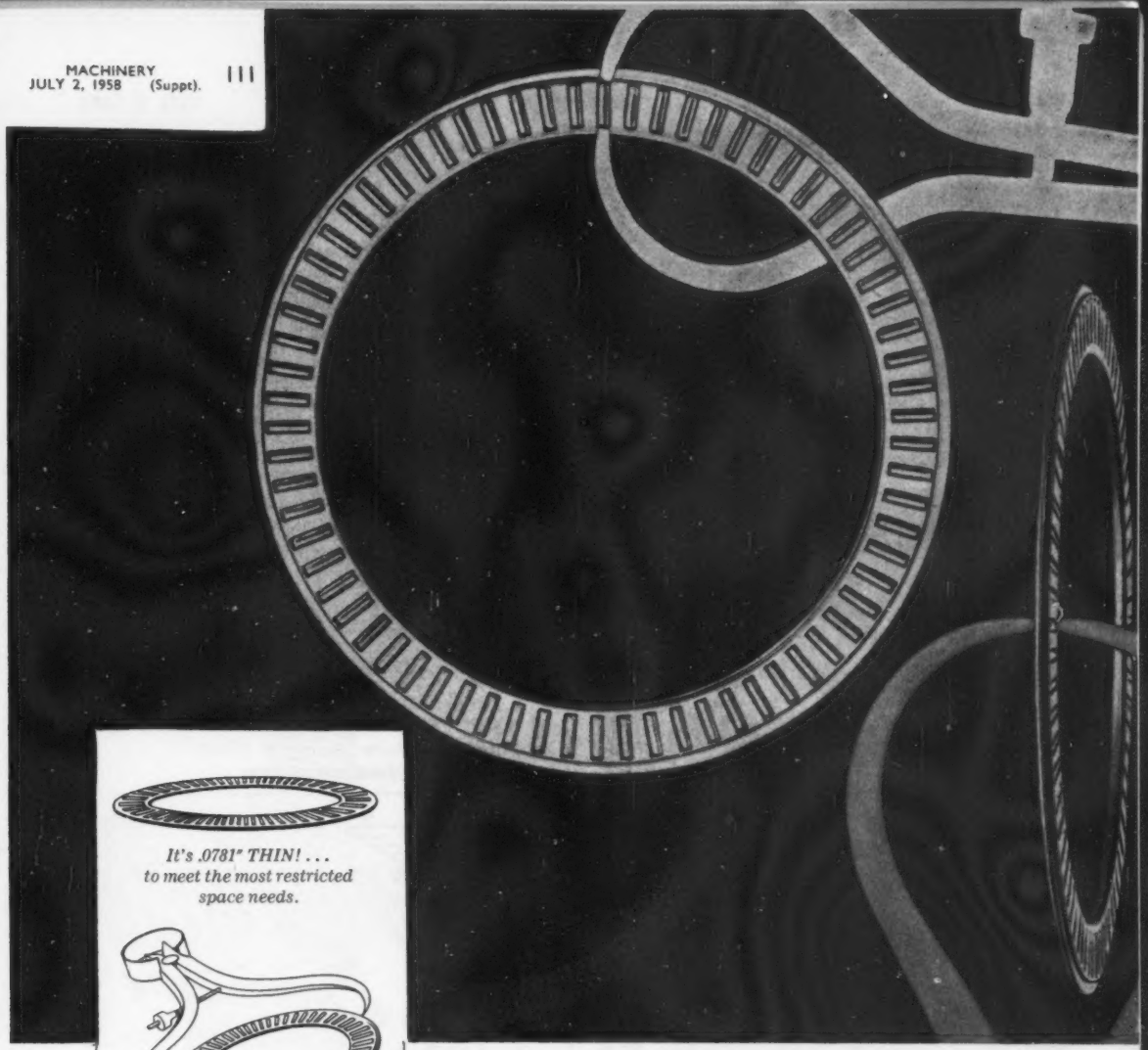

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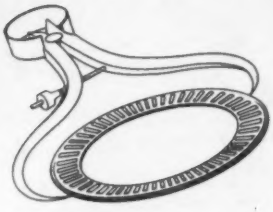

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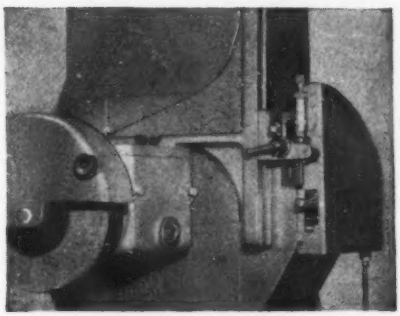

This feature is designed to relieve the operator of the duty of inching on small increments of feed at every table stroke over the relatively large distances such as may be required on some types of form ground work.

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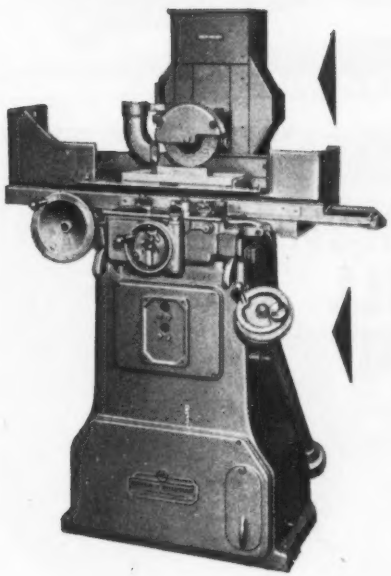

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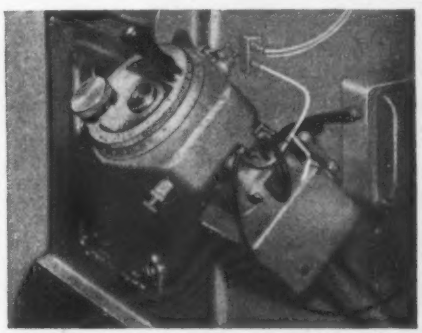

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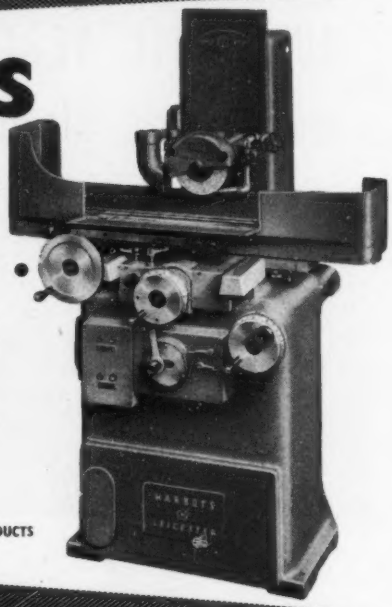

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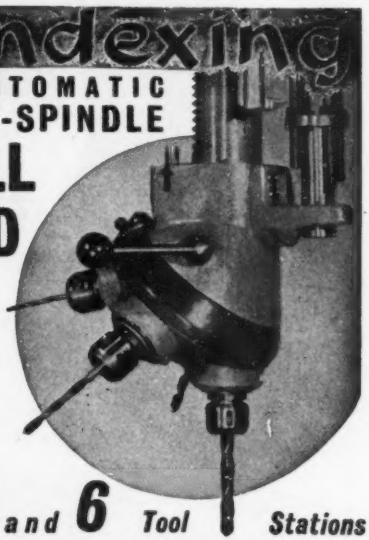

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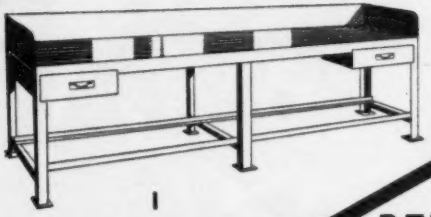
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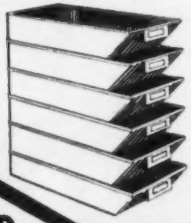
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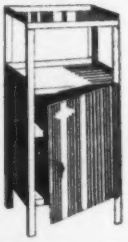
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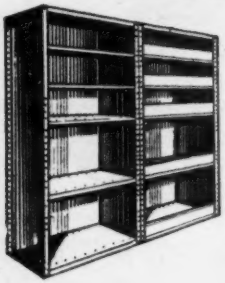
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2. Stacking Trays
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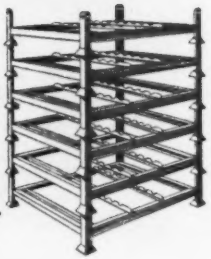

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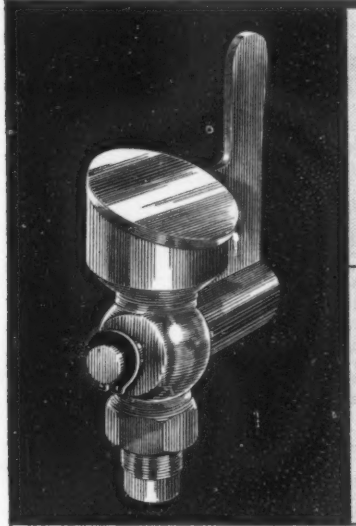

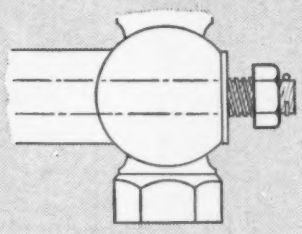

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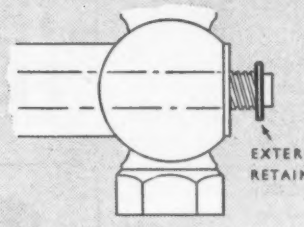

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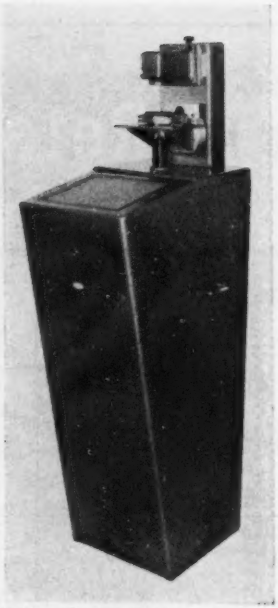

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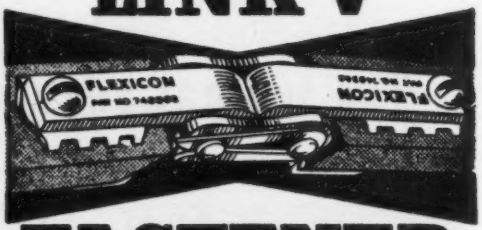

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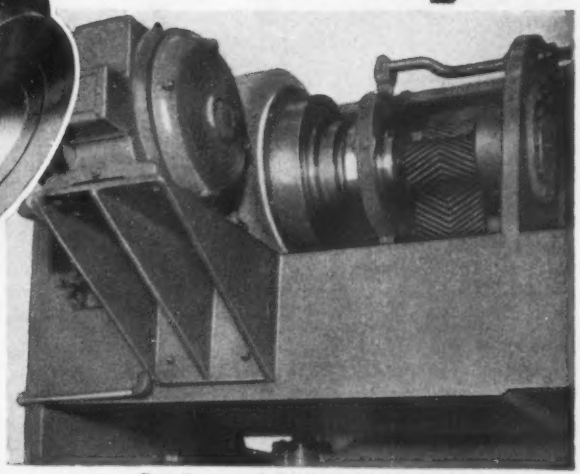

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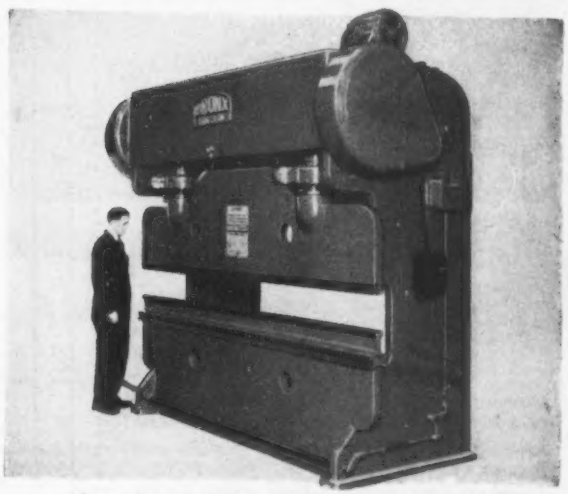

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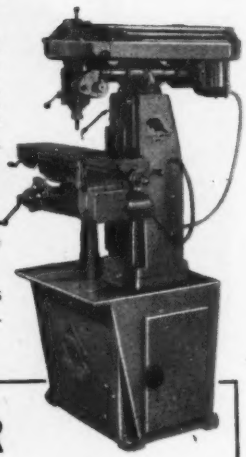

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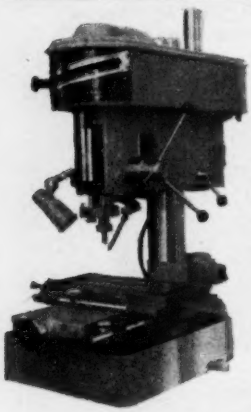

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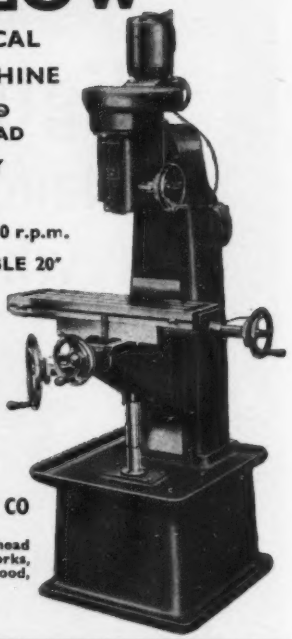

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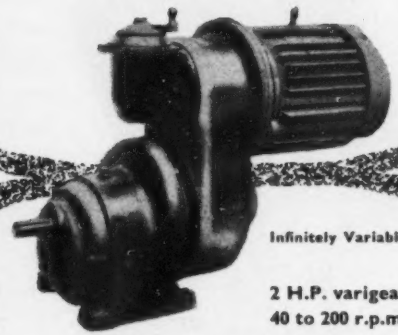

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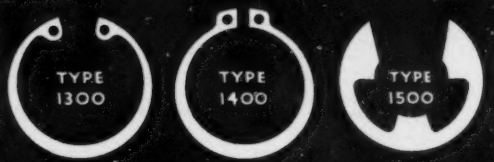

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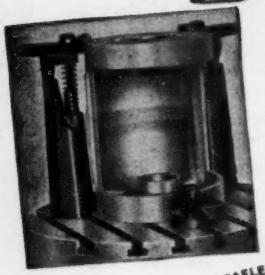

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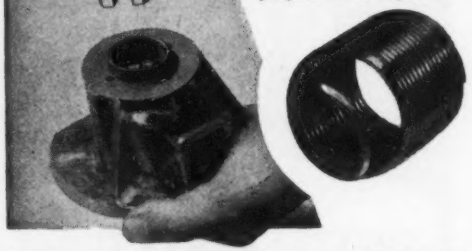

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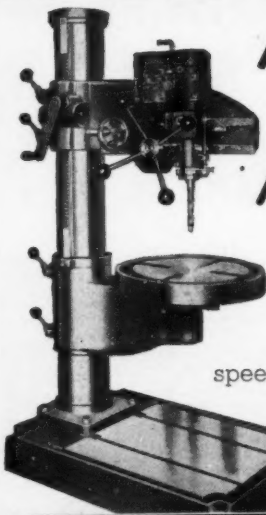

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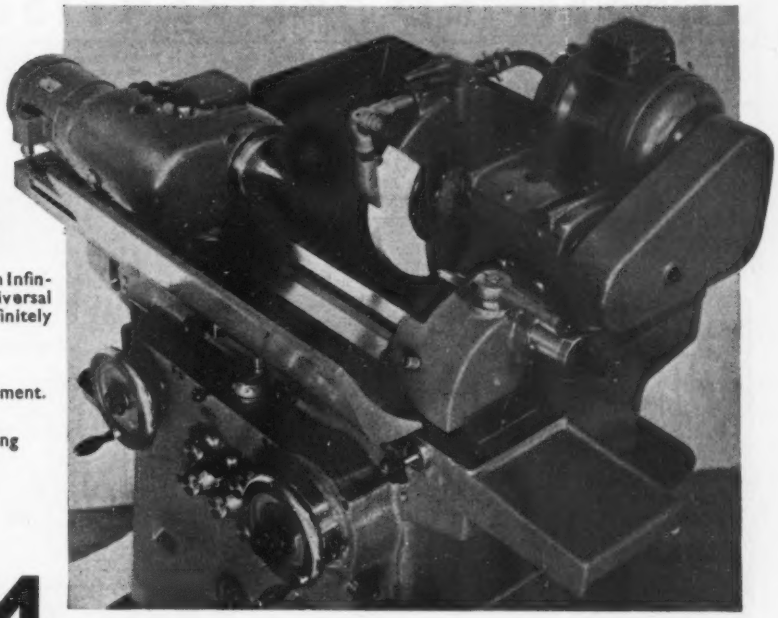

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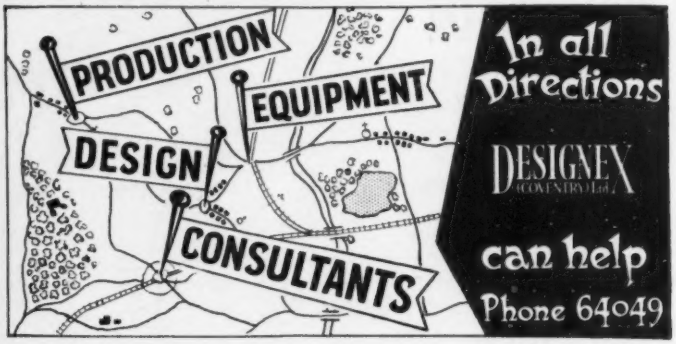

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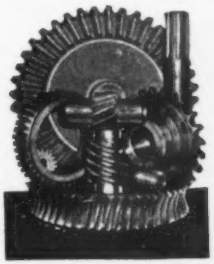

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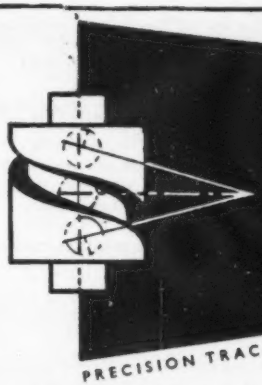

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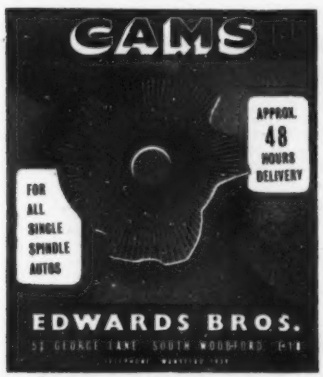

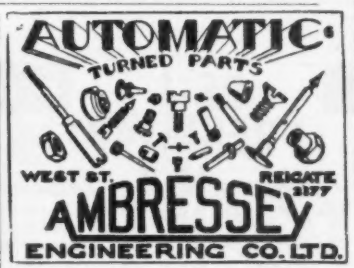

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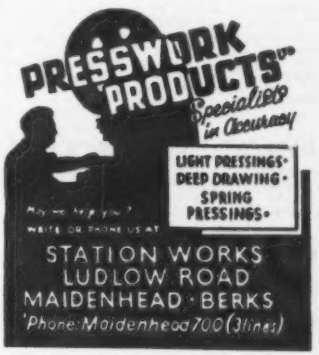

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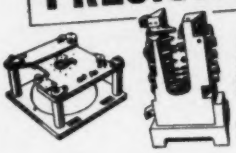
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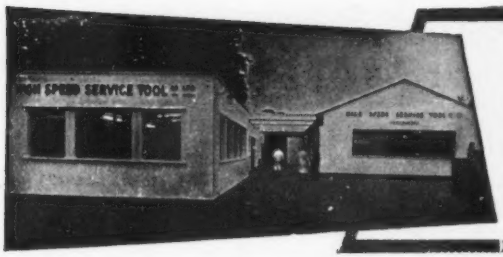

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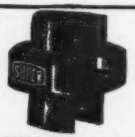

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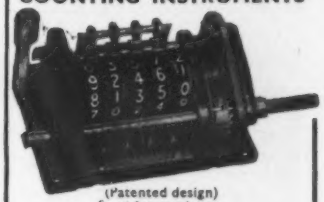

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Only modern machines considered.—BOX Z61, MACHINERY, Clifton House, Euston Road, N.W.1.

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CLIFTON & BAIRD Punching and Cropping Machine. Capacity 4½in. by 4½in. by ½in. angle.
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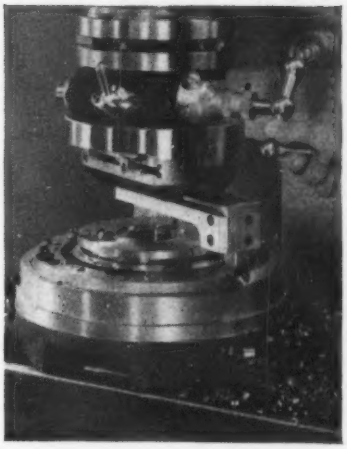

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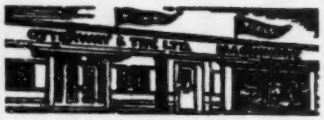

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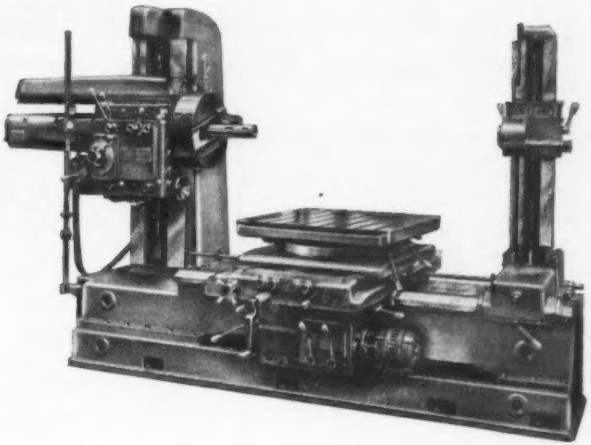

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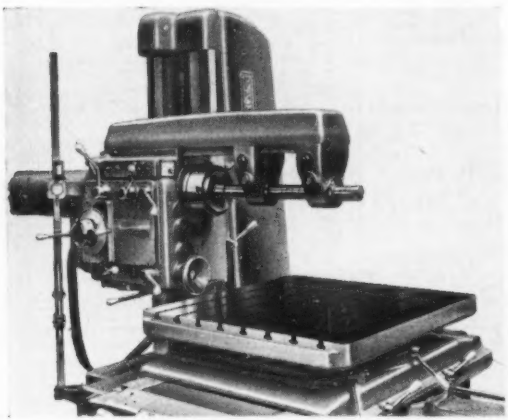

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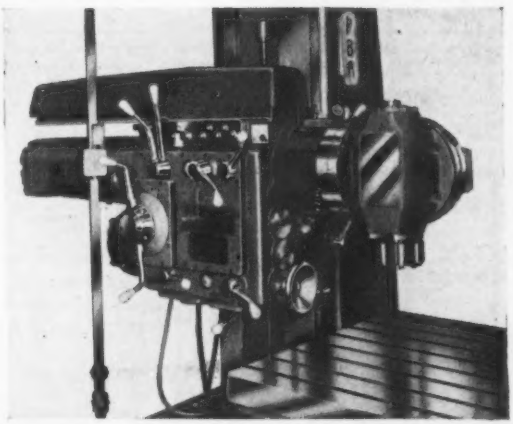

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K·E·N·T

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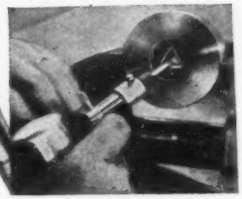

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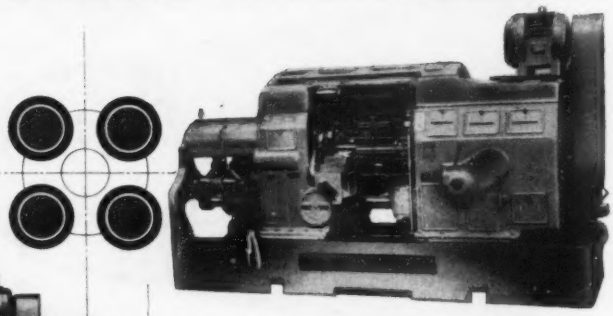

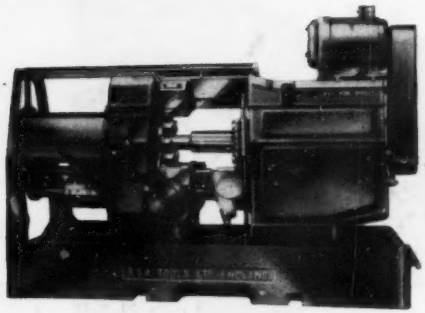

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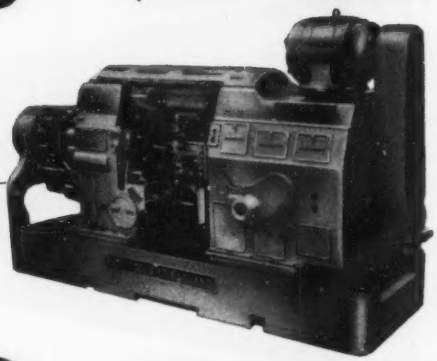
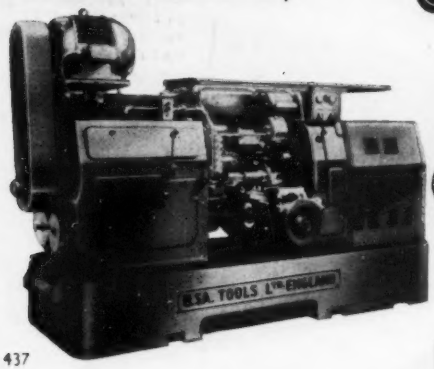
1⅝"
EIGHT SPINDLE





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